THE REFINER AND NATURAL GASOLINE MANUFACTURER

JANUARY, 1927

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ADVERTISERS INDEX . . 106

VOLUME 6 NUMBER 1

JENKINS CRACKING PROCESS

PRODUCES QUALITY GASOLINE

Facts from performance

Complete—

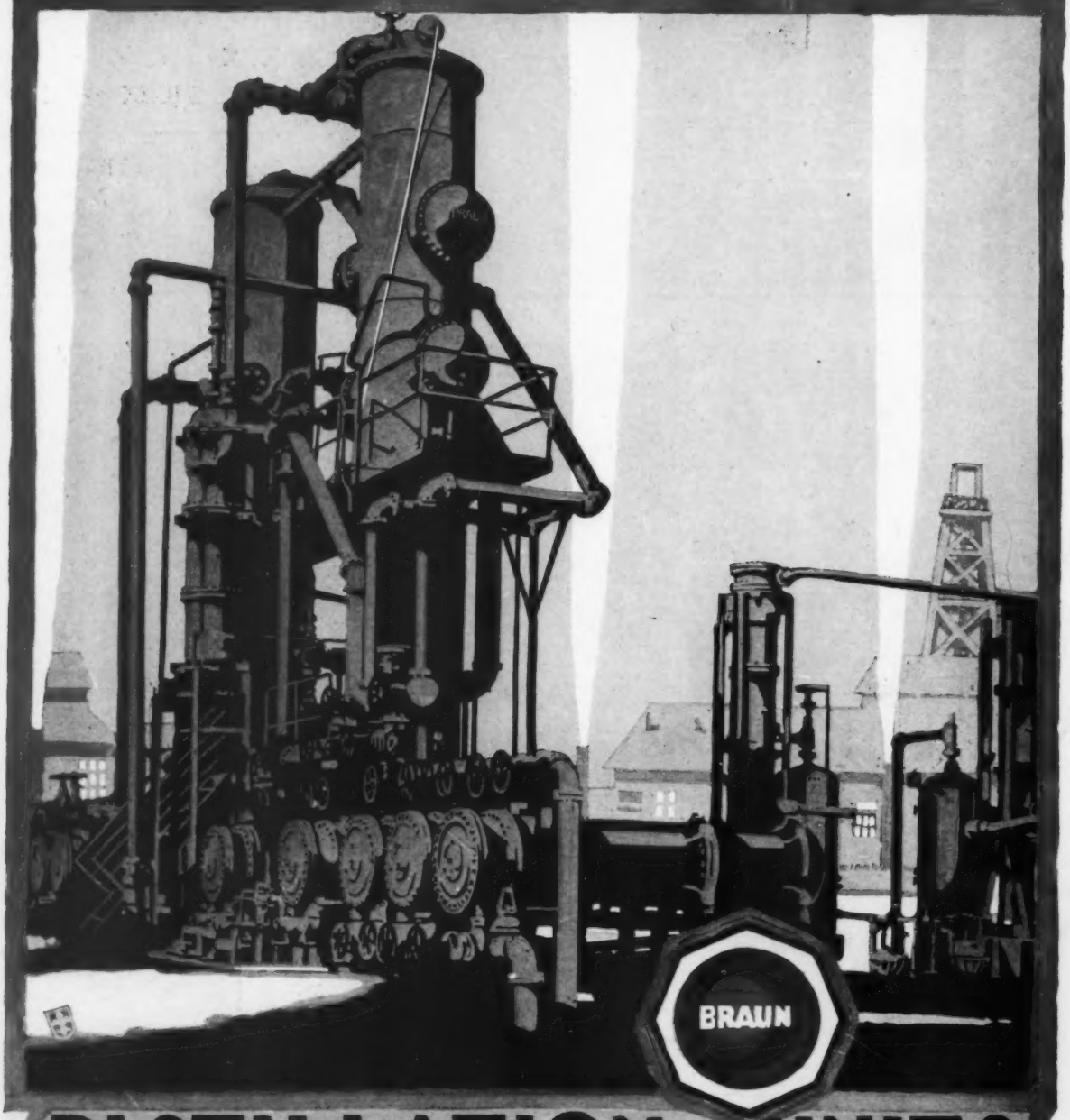
The Jenkins Cracking Process uses its own recycle stock.

No degraded products are left for the balance of the refinery to reclaim or for the sales department to sell at a loss.

GRAVER Corporation Founded 1857
EAST CHICAGO, INDIANA

NEW YORK Grand Cent. Term. | CHICAGO Steger Building | TULSA Atlas Life Bldg. | HOUSTON West Building

B·R·A·U·N



DISTILLATION UNITS

C. F. BRAUN & CO
MANUFACTURING MECHANICAL
ENGINEERS

TULSA ALHAMBRA, CALIF. DALLAS

Entered as second class matter June 16th, at the Postoffice at Houston, Texas, under the Act of March 3, 1879.

PITTSBURGH SEAMLESS

Boiler Tubes Still Tubes
Oil Country Tubular Goods

"Pittsburgh Seamless" Steel Tubes have long been favored for boiler construction and repairing. They are low in sulphur and phosphorus to resist pitting and corrosion and are eminently suited for oil stills. They have high tensile strength and elastic limit, possess a high factor of safety, and are easily installed.

Pittsburgh Seamless Tubes

are made from pierced solid billets of basic open hearth steel. They are made in accordance with A. S. M. E. and A. S. T. M. or other similar specifications. We do swaging, swelling, upsetting and bending where such special work is required. Warehouse stocks at convenient points assure prompt service. Your inquiries will be appreciated.

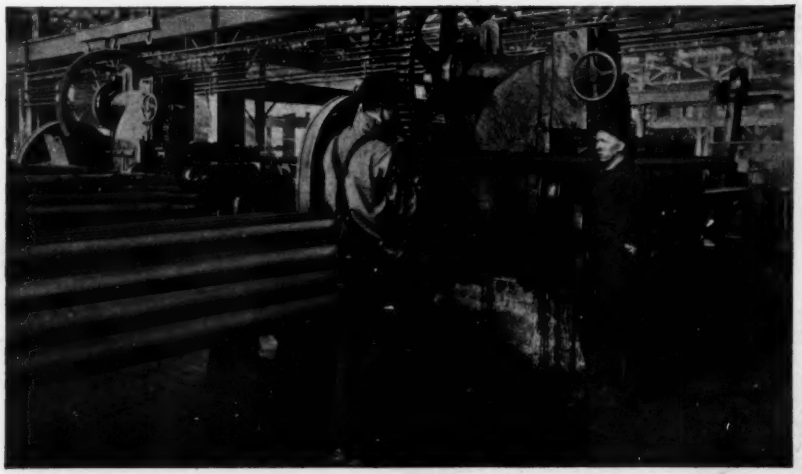
Pittsburgh Steel Products Co.

Pittsburgh New York Detroit Chicago

Second National Bank Bldg., Houston, Texas

Atlas Life Bldg., Tulsa, Oklahoma

Straightening Tubes



Mention Where You Saw the Advertisement

529335

SUNOCO

A New Years Greeting.....

We appreciate that so many Natural Gasoline Plant Operators are using Sunoco Absorption Oils 630 and 670.

Owing to the great demand, it has been necessary to increase our plant facilities.

We extend our sincere appreciation and trust we may have the pleasure of serving you in 1927.

Ask us for a list of satisfied users

Quotations and samples furnished on request. If desired a representative will call.

SUN COMPANY

PETROLEUM BLDG., TULSA, OKLAHOMA

Refineries at

Marcus Hook, Pa. Yale, Okla. Toledo, Ohio

Mention Where You Saw the Advertisement

Making Good the Guarantee

Williams Double-Disc Gate Valve No. 127—representing the height of valve service. Ask your dealer for it.

No effort to shirk responsibility! No grumbling over severity of the service demanded! No "ifs or ands" or quibbling of any nature!

Service at a profit! That is the plainly understood proposition on which all **Williams Valves** are sold. Discriminating valve buyers know the **Williams** saves coal, labor, time and trouble, and assures uninterrupted production. Profits from such service are incalculable.

Williams Double-Disc Gate Valve No. 127

is one of the peerless **Williams** line that is famed for abolishment of all waste—for the insurance of a full, steady and leakless flow of Air, Steam, Water, Gas or Oil.

A tight seat is assured by the ball and socket bearing discs that also compensate for any temperature distortion or sagging of pipe lines.

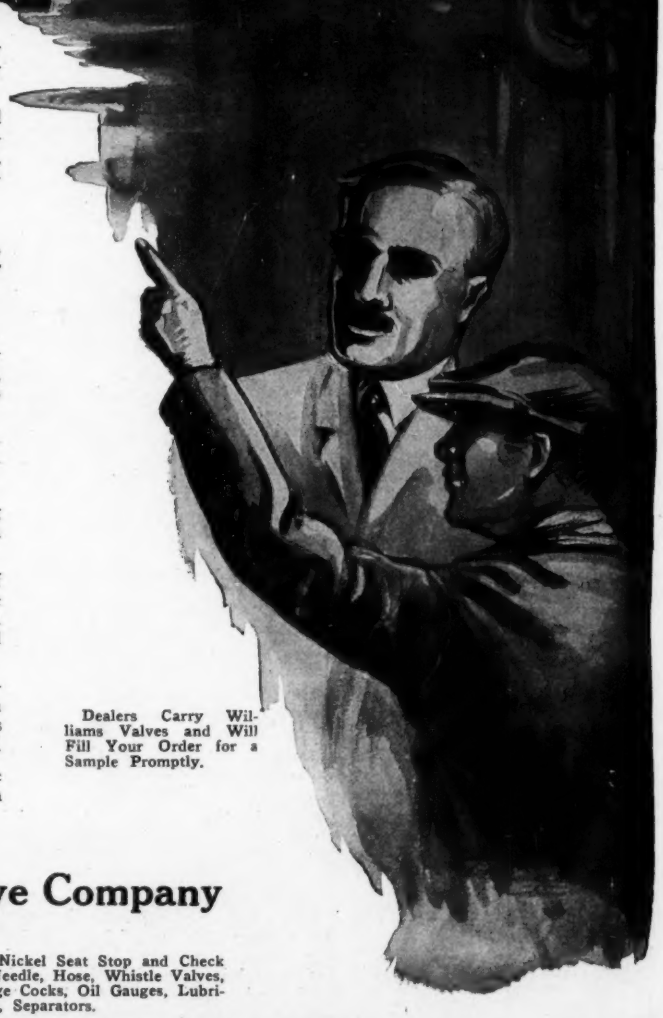
An **exclusive** Williams feature is the Union Ring method of securing the bonnet to the body, providing a rigid, steam-tight joint that cannot corrode.

The heaviest stem used in any gate valve—made of special hard bronze that will not bend or break. Acme Standard threads assure maximum wear and long life. Packing is forced against the stem by a Packing Gland Follower.

Many other features that explain the extremely satisfactory service of Williams Valves are described in our Catalogue 10. It clearly explains why Williams Double-Disc Gate Valve No. 127 always makes good.

Made in two patterns—Medium for 200 lbs. pressure and Extra Heavy for 300 lbs. pressure.. **Satisfaction Guaranteed.**

Catalogue No. 10 mailed on request.



Dealers Carry Williams Valves and Will Fill Your Order for a Sample Promptly.

The D. T. Williams Valve Company

Cincinnati, Ohio

Makers of High Grade Bronze and Iron, Regrinding and Nickel Seat Stop and Check Valves, Gate, Blowoff, Hydraulic, Swing and Ball Check, Needle, Hose, Whistle Valves, Stop and Air Cocks, Unions, Fittings, Water Gauges, Gauge Cocks, Oil Gauges, Lubricators, Oil and Grease Cups, Steam Traps, Separators.

Williams Valves

Mention Where You Saw the Advertisement

These Distributors stock **ADAMANT** *in 100 lb., 250 lb., and 400 lb. containers. Distributors are listed under state and city, with states arranged alphabetically.*

Alabama, Birmingham,
Young and Vann Supply Company
California, Los Angeles,
Industrial Supply Co.
California, San Francisco,
W. E. Mushet Co.
Colorado, Denver,
H. W. Thompson
Connecticut, New Britain,
Rockliffe Bros. Co., Inc.
Connecticut, New Haven,
The Warner-Miller Co.
Illinois, Chicago,
Wm. E. Dee Company
Indiana, Fort Wayne,
Coen Equipment Co.
Indiana, Indianapolis,
Indianapolis Belting & Supply Co.
Iowa, Des Moines,
The Walrodh Supply Company
Kentucky, Louisville,
E. D. Morton & Company, Inc.
Kentucky, Paducah,
Henry A. Petter Supply Company
Louisiana, New Orleans,
Woodward Wight & Company, Ltd.
Louisiana, Shreveport,
Woodward Wight & Company, Ltd.
Maryland, Baltimore,
King's Coal and Supply Company, Inc.
Massachusetts, Boston,
Waldo Bros. and Bond Company
Massachusetts, Springfield,
Oscar F. Carlson
Massachusetts, Worcester,
Waldo Bros. and Bond Company
Michigan, Detroit,
H. D. Edwards & Co.
Minnesota, Duluth,
Duluth Builders Supply Co.
Minnesota, Minneapolis,
Northern Machinery Company
Missouri, Kansas City,
Union Material & Supply Co.
Missouri, St. Louis,
Reed Railway Supply Co.
Nebraska, Omaha,
American Machinery & Supply Co.
New York, Buffalo,
The Curtis Supply Co., Inc.
New York, Mohawk,
The American Hard Wall Plaster Co.
New York, New York,
C. C. Phillips, 110 W. 34th St.
New York, Rochester,
American Clay & Cement Corp.
Wm. Summerhays & Son
New York, Rome,
The American Hard Wall Plaster Co.
New York, Syracuse,
The Paragon Plaster Company
New York, Utica,
The American Hard Wall Plaster Co.
Ohio, Cincinnati,
The Wm. T. Johnston Co.
Ohio, Cleveland,
The Cleveland Tool & Supply Co.
Ohio, Columbus,
The Westwater Supply Co.
Ohio, Dayton,
The Klinger-Dills Co.
Ohio, Toledo,
The Toledo Builders Supply Co.
Oklahoma, Tulsa,
Standard Asbestos & Cork Company
Oregon, Portland,
The M. L. Kline Co.
Pennsylvania, Aspinwall,
The Gas Combustion Company
Pennsylvania, Erie,
O. C. Thayer and Son
Pennsylvania, Pittsburgh,
The Gas Combustion Company
Post Office Box No. 1753
Pennsylvania, Reading,
Reading Foundry and Supply Co.
Rhode Island, Providence,
B. & H. Supply Co., Inc.
South Carolina, Columbia
Columbia Supply Company
South Carolina, Spartanburg
Spartanburg Mill Supply Co.
Tennessee, Memphis,
Reed and Duecker
Texas, Beaumont,
Norvell-Wilder Hardware Company
Texas, Corpus Christi,
San Antonio Machine & Supply Co.
Texas, Dallas,
The Murray Company
Texas, El Paso,
Geo. S. Thomsen Company
Texas, Houston,
Norvell-Wilder Hardware Company
Texas, San Antonio,
San Antonio Machine & Supply Co.
Texas, Waco,
San Antonio Machine & Supply Co.
Virginia, Norfolk,
Empire Machinery & Supply Corp.
Washington, Seattle,
Cragin & Co.
Washington, Spokane,
Consolidated Supply Company
West Virginia, Charleston,
South Side Foundry & Machine Works
West Virginia, St. Albans,
Edw. C. Kirk & Sons
Wisconsin, Milwaukee,
Tews Lime & Cement Co.
Wisconsin, Superior,
The Speakes Company

Canadian Distributors

British Columbia, Vancouver,
B. C. Equipment Company, Ltd.
Manitoba, Winnipeg,
Walter Reives & Company, Ltd.
Ontario, Hamilton,
Thomson-Gordon, Ltd.
Ontario, Port Arthur,
Wells & Emmerson
Ontario, Toronto,
J. H. Morrison
Quebec, Montreal,
Alex. Bremner, Ltd.

The How *and* Why *of* Better Fire Brick Construction

LESS than a quarter-century ago, fire clay mortar was universally used for laying up fire brick. But it did little more than serve as a means to bring the courses of brick to the desired level.

A crude product as it came from the mine, fire clay contained much natural moisture. Under heat, the moisture evaporated. Joints between brick shrunk and crumbled. The fire clay fell out in the form of dust. Lacking a bond between brick, the furnace lining was short-lived. Brickwork troubles and furnace re-linings were frequent.

The disadvantages of fire clay, which are recognized today in practically every refinery, caused the founder of Botfield Refractories Company to seek an improved material for laying up fire brick. "If I could only weld the brick together," he thought, "to obtain the same result as two pieces of iron that have been welded—"

From that vision, he developed the first high temperature cement for bonding fire brick, which he named ADAMANT Fire Brick Cement. Pioneer of ALL high temperature cements, ADAMANT possessed many superiorities over fire clay. Today, more than ever, ADAMANT has unique properties not found in other bonding materials.

ADAMANT'S air-set, its tenacious, all-temperature bond, the ease with which it works, its freedom from shrinking or cracking in setting, its adaptability to thin, "dipped" joints, its unusual resistance to brick-destroying actions, its freedom from lumping and similar waste, its economy in amount required—these and many other advantages tell why many well-known refineries have standardized on ADAMANT and why more and more refineries are adopting ADAMANT for building fire brick construction.

Assuming that the proper grade and type of fire brick is being employed for each furnace condition, brickwork life is dependent on the strength of the joints, and on the protection provided for the exposed surfaces of the fire brick.

To obtain the required strong joints, fire brick should be laid up with ADAMANT Fire Brick Cement, using thin joints, preferably obtained by "dipping."

Made with ADAMANT, joints are *actually stronger than the brick*—the reason why still settings laid up with ADAMANT cannot "creep" or "travel." In addition, ADAMANT joints are free from shrinking or cracking in setting. They do not crumble or open under heat, nor are they affected by expansion and contraction of the brick, or by sudden temperature changes.

The bond of an ADAMANT joint is constant throughout the entire temperature range from air-set to the highest furnace heat — a property possessed only by ADAMANT.

To protect the brickwork from destructive actions, exposed surfaces should be "faced" with one or two THIN brush coatings of ADAMANT. By the addition of water, ADAMANT can be quickly "cut" to a creamy consistency that brushes readily. ADAMANT coatings should be worked well into the pores of the brick, into all cracks and joints, just as paint should be worked into the grain of wood. Under heat, these ADAMANT coatings form a glaze that protects the brickwork from corroding gases, from the cutting action of flame, from the penetration of carbon and from other elements that shorten brickwork life. In addition, the ADAMANT glaze retards the adherence of clinker, and enables clinker to be knocked off without tearing out large sections of the brickwork.

For patching burned out sections of fire brick construction, a mix of ADAMANT and crushed fire brick has proved ideal. Usually, the best mix is one of equal parts of ADAMANT and crushed brick, but as it varies with conditions the proper percentage should be determined by experiment. Frequent inspection of fire brick construction, and repairs with the ADAMANT mix when necessary, prevent many costly shutdowns and often defer an expensive relining.

"Whenever a fire brick is used, lay up, 'face' and patch with ADAMANT" has become a standard specification in some of the most prominent refineries, because ADAMANT has proved its ability to prolong the life of fire brick construction, and to minimize the cost of refractories repairs.

In 100 lb., 250 lb. and 400 lb. air-tight, metal containers, ADAMANT is stocked in every refining district. 400 pounds of ADAMANT are sufficient to lay up 1000 fire brick—another feature of ADAMANT economy.

Listed in the column at the left of this page is a distributor near you who will be glad to supply your needs of ADAMANT.

For further information, write us for a copy of the ADAMANT book, or data on ADAMANT service in still settings, boiler furnaces, Fuller's Earth kilns, bone black furnaces, tube heaters or other types of refinery furnaces.

Botfield Refractories Co.

783 S. Swanson St., Philadelphia, Pa.

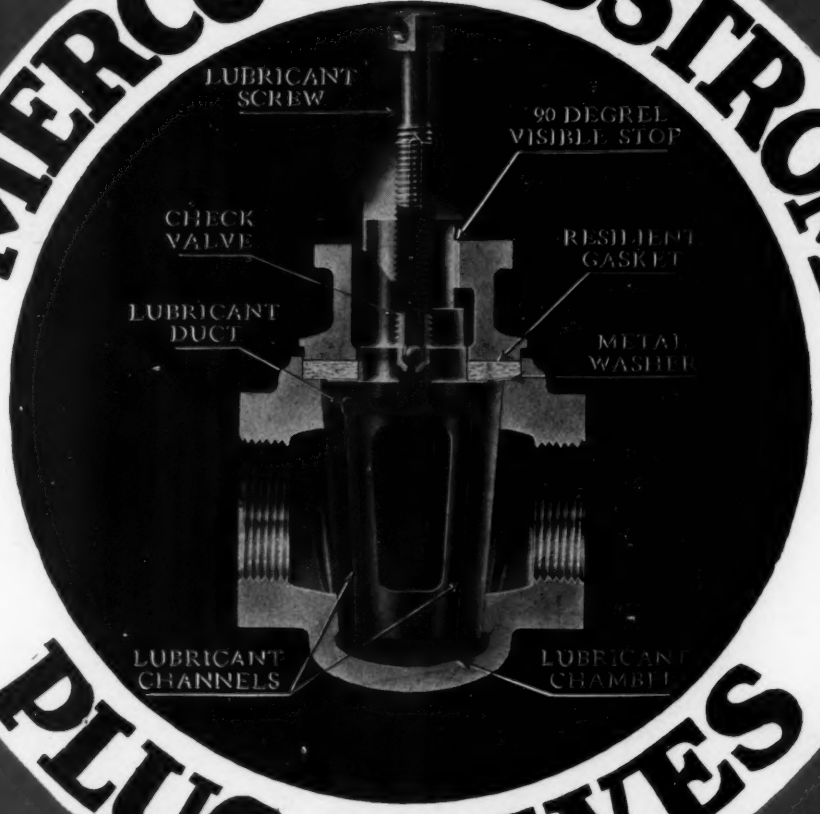
New York Office: Fifth Floor 110 W. 34th St.

Whenever You Use A Fire Brick, Use ADAMANT The Original High Temperature Cement

ADAMANT
FIRE BRICK CEMENT

Mention Where You Saw the Advertisement

MERCO NORDSTROM PLUG VALVES



Eminently Satisfactory for *Gasoline Plant Service*

Observe that this valve uses lubricant directly to the bottom of the plug, UNDER PRESSURE, to prevent entry leakage is positively prevented. Our of any foreign matter. With a pressure catalog mentions many other exclusive of 2000 lbs. to the square inch transmitted features.

MERCO NORDSTROM VALVE COMPANY

SUBSIDIARY OF THE MERRILL COMPANY

Engineers— Manufacturers

MERCO

San Francisco 121 Second Street — New York 110 W. 40th Street — Chicago Peoples Gas Building — Houston 613 Washington Avenue — Cleveland 525 Engineers Building — Agencies at Principal Cities

Mention Where You Saw the Advertisement

The Holmes-Manley *Cracking* Process

An outstanding Engineering Achievement made possible through constant progress in design and repeated construction over a period of years. ' ' '

The Licensee receives:—

1. *A Proven Process*
2. *Complete Technical Service*
3. *The Benefit of Future Developments*

Licenses Granted by

THE TEXAS COMPANY, U. S. A.

Apply to

W. S. S. RODGERS

17 Battery Place, New York, N. Y.

Mention Where You Saw the Advertisement

BANROC JACKET

BANROC PRODUCTS

3. Permanent

Tests prove that some of the original BANROC WOOL has the same high efficiency after twenty-nine years of severe service. What could be better proof of Permanence?

The fibres of the BANROC WOOL used in BANROC JACKET are not subject to chemical reactions which cause disintegration. Atmospheric conditions do not affect their permanency.

BANROC JACKET has been used for years for insulating railroad tank cars carrying hot oils. Numerous inspections prove that the insulation is unaffected by this severe vibration of railroad service.

Not only is the BANROC WOOL permanent, but the copper bearing metal fabrics used in BANROC JACKET are assurance of their permanency.

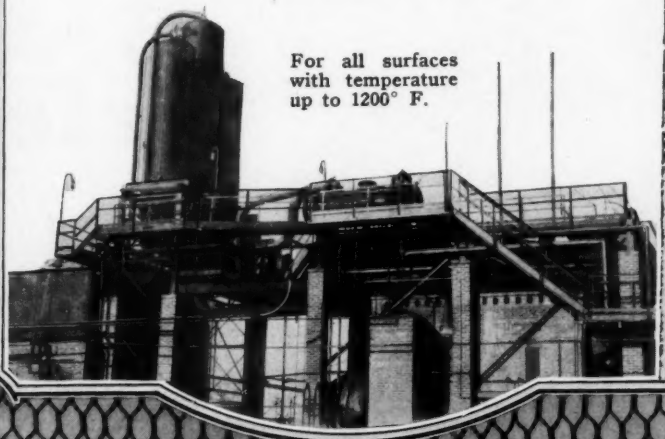
Made in special sizes to meet your requirements, or furnished in standard sizes, 2x4 ft. and 2x8 ft.

Send us your specifications. Write for samples and descriptive Bulletin 17-R.

1. Adaptable
2. Flexible
3. Permanent
4. Reclaimable
5. Efficient
6. Economical

BANROC JACKET

100% FIREPROOF INSULATION



For all surfaces with temperature up to 1200° F.

BANNER ROCK PRODUCTS COMPANY

ALEXANDRIA, INDIANA

REPRESENTATIVES IN ALL PRINCIPAL CITIES

You'll truly have A Prosperous New Year

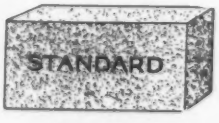
From the standpoint of refractory efficiency, lower freight cost, and repair economies, you'll truly have a more Prosperous New Year if you use

TEXAS Fire Brick

Elgin Butler Brick Co.,
Austin, Texas

Athens Brick & Tile Co.,
Athens, Texas

Texas Clay Products Co.,
Malakoff, Texas



Acme Brick Co.,
Ft. Worth, Texas

SERVING more than 85 per cent of fire brick needs, and affording, as a local product, the economies of short freight hauls, Texas Fire Brick enables the Southwestern Refiner to get precisely the grade brick he requires at a lower cost than he ordinarily pays. Texas Fire Brick dependably and economically meets the needs of Baffle Brick, Bridge Walls, Shell Still, Cracking Stills and boilers operating under normal heat ratings. Now used by refiners who once thought more costly brick necessary.

Write any member for figures
on your requirements

Texas Fire Brick Manufacturers' Association
Promoting Texas Fire Brick Economies

Horizontal Tanks
Condenser Boxes
Rundown Tanks
Storage Tanks
Agitators
Towers
Stacks
Stills

The Service Behind the Product

There is something more than men, material and machinery behind the production of KAW refinery equipment.

There is an honest determination to serve the customer better—to build refinery equipment that meets the needs of refiners who want the best—to give every customer quick shipment, no matter how large or how small the order.

The good reputation KAW products have won and now hold proves KAW'S ability to fulfill these quality service requirements.

KAW Service can help you. Write, wire or phone for money-saving specifications and prices.

THE KAW STEEL CONSTRUCTION CO.

General Office and Plant:
1st and Walker Ave.

KAW

KANSAS CITY, KANS.

THE SUPER STRENGTH IS BUILT IN!

Mention Where You Saw the Advertisement

THE CROSS CRACKING PROCESS

Briefly, the reasons for leading refiners, during the past few months, placing REPEAT orders for CROSS Cracking Units, exceeding 94,000 bbls. daily capacity, are:

1. LOWEST OVER ALL COST per gallon of gasoline produced.
2. GREATEST PROFIT from each barrel of ANY stock processed.
3. DEPENDABILITY, greatest per cent of time on stream.
4. SAFETY.
5. Their realization that the use of CROSS Units is "CONSERVATION" in its true sense.

THE M. W. KELLOGG CO.

7 Dey St., New York City.

Branch Offices:
700 Baltimore Ave., Kansas City, Mo.
444 Market St., San Francisco, Calif.
1019 Hellman Bank Bldg., Los Angeles, Calif.

Around the World With Silvr-Cool

Silvr-Cool is known throughout the world as the Super-Aluminum Paint.

The reason is that Silvr-Cool has demonstrated its ability to stand up year after year, under unusual conditions of exposure.

Silvr-Cool is the best known Aluminum Paint. Silvr-Cool is used by the largest consumers of Aluminum Paint in the United States. Its use is world wide and its worth has been proven in

Argentine	Cuba	Japan	Sumatra
Australia	Curacoa, B. W. I.	Mexico	Trinidad
Borneo	Colombia	Morocco	Uruguay
Brazil	Chile	New Zealand	Venezuela
Burma	Egypt	Peru	Portuguese E. Africa
Canada	England	Porto Rico	United South Africa
China	Formosa	Roumania	

In practically every country where oil is produced and stored, Silvr-Cool is known as the Aluminum Paint that costs less per year.

Silvr-Cool is always ready for use

SILVR-COOL

The Super-Aluminum Paint

—IS MADE BY—

Detroit Graphite Company

DETROIT, U.S.A.

Manufactured **in Canada by Dominion Paint Works, Limited, Walkerville, Ontario.** ***Offices*** **at all principal centers.**

SAFEMCO

PAINTS

Made for
the Southwestern
Oil Industry

THEY STAND THE TEST OF SERVICE!

AMERICAN
PAINT & SUPPLY COMPANY

DALLAS, TEXAS

Mention Where You Saw the Advertisement

SOUTHWESTERN
FACTORY BUILT

ABSORPTION PLANTS

A Factory Built Plant for every condition & capacity

Type 25
(PORTABLE)
2,500 to 3,000 Gallons

Type 75
7,500 to 10,000 Gallons

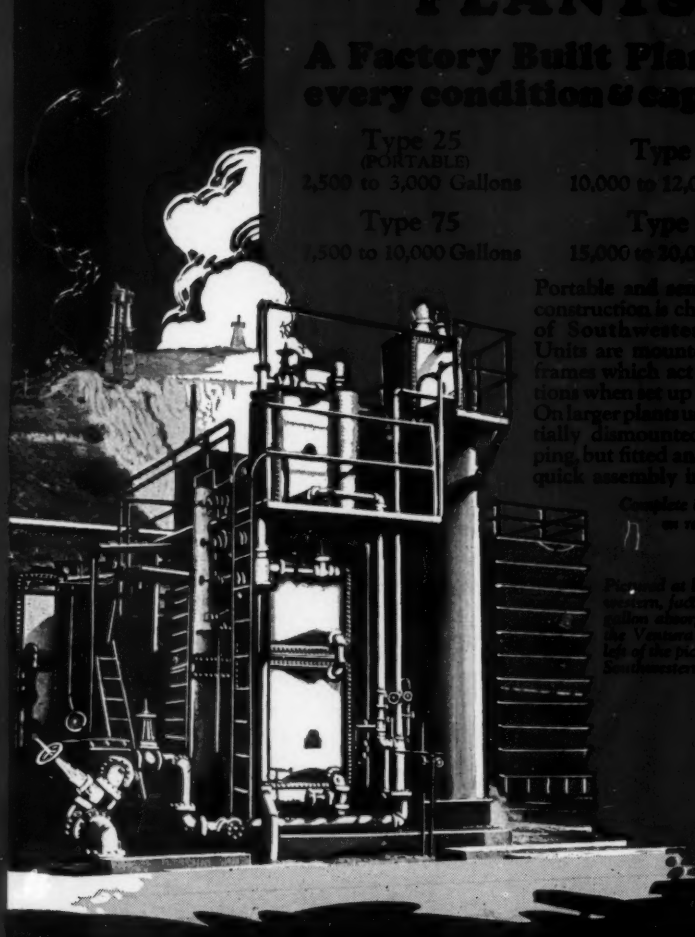
Type 100
10,000 to 12,000 Gallons

Type 180
15,000 to 20,000 Gallons

Portable and semi-portable construction is characteristic of Southwestern plants. Units are mounted on steel frames which act as foundations when set up in the field. On larger plants units are partially dismounted for shipping, but fitted and piped for quick assembly in the field.

Complete information on request

Pictured at left is a Southwestern, factory built, 7500 gallon absorption plant in the Ventura field. At the left of the picture is a small Southwestern portable.



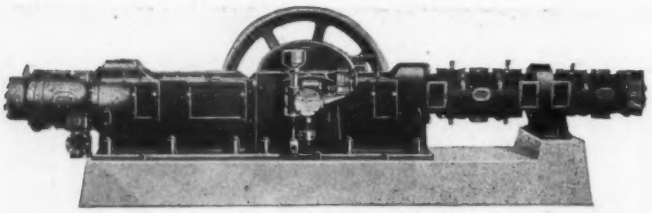
SOUTHWESTERN ENGINEERING CORPORATION LOS ANGELES U.S.A.

SOUTHWESTERN ENGINEERING CORP.

1221 HOLLINGSWORTH BLDG.
Los Angeles Calif.

Offices
TULSA
AMARILLO TEXAS
NEW YORK

CULVER CITY CAL.



Old in Air Work

HIGH pressure air work is nothing new to Bessemers. They have been used in this service for years and it was Bessemer that pioneered in building compressors for this kind of work. For years the Bessemer two-cycle two-stage high pressure compressor has served the Oil Industry, and

Time Tried and

the Bessemer four-cycle two-stage unit for this same service has been thoroughly time tried and field tested.

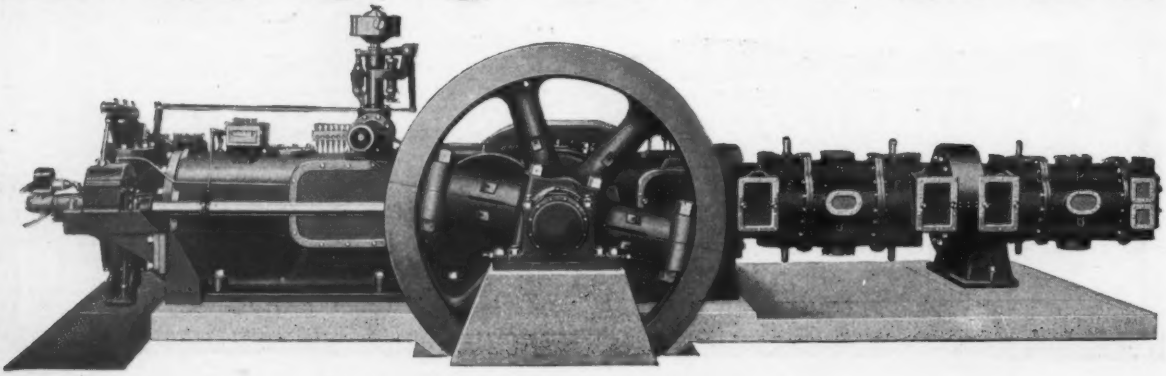
For flowing wells, Bessemer compressors (two-cycle and four-cycle) were the first compressors built and developed for this type of service. They

Field Tested

are old in service, proved by performance and have a long record of highly efficient and thoroughly dependable service behind them. You play safe on the side of performance and economy with these proved-by-performance Bessemers.

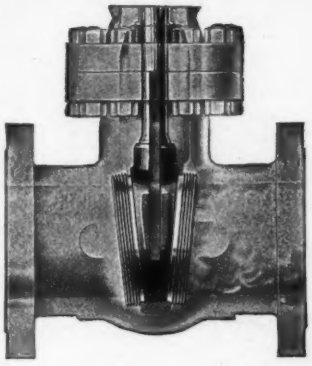
THE BESSEMER GAS ENGINE COMPANY
18 York Street ∴ ∴ Grove City, Pa.
California Branch: 727-728 Standard Oil Bldg., Los Angeles
California Distributer: Associated Supply Co., San Francisco—Los Angeles

BESSEMER



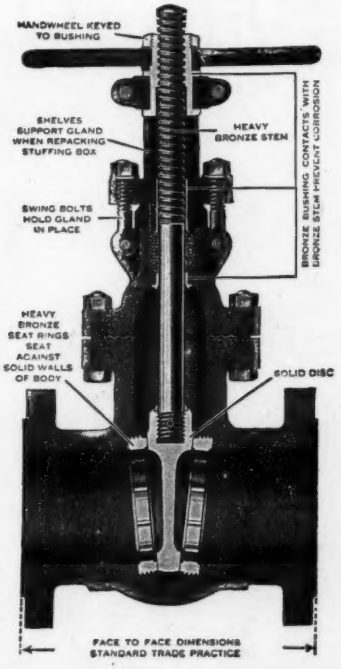
Mention Where You Saw the Advertisement

Accurately Machined Guides Protect Seat Faces



The long ribs in the body as well as grooves in the disc are carefully machined and engage with a clearance so small and accurately gauged that pressure from either side cannot force disc against opposite seat. Thrust of the disc is against the guides and not against seats. The disc rides straight and true to its seat without changing on seat faces. Chattering of the disc with its disastrous effects on the seat rings is eliminated, and the life of these vital parts of the valve is materially prolonged.

LUNKENHEIMER
IRON BODY BRONZE MOUNTED
GATE VALVES


HANDWHEEL KEYED TO BUSHING
SHELVES SUPPORT GLAND WHEN REPACKING STUFFING BOX
HEAVY BRONZE STEM
BRONZE BUSHING CONTACTS WITH BRONZE STEM PREVENT CORROSION
SWING BOLTS HOLD GLAND IN PLACE
HEAVY BRONZE SEAT RINGS SEAT AGAINST SOLID WALLS OF BODY
SOLID DISC
FACE TO FACE DIMENSIONS STANDARD TRADE PRACTICE

embody many other distinctive features which stamp these designs as an outstanding development in gate valve construction.

The sectional view shows at a glance the numerous refinements, the simplicity of design, the rigid construction, and the careful attention to manufacturing details. These are factors which insure the highest degree of dependable service, with minimum maintenance expense.

Lunkenheimer Iron Body Bronze Mounted Gate Valves are made in two designs—Stationary Stem Inside Screw and Rising Stem Outside Screw and Yoke. Either design is procurable in the Standard Pattern, 125 lb. W.S.P.; Heavy, 175 lb. W.S.P.; Extra Heavy, 250 lb. W.S.P.

Lunkenheimer Distributors, located in all oil producing centers, carry complete stocks and render prompt service. Call on them for your requirements.

Complete information is contained in Gate Valve Book F. 511, a copy of which will be sent upon request, without any obligation.
JUST FILL IN AND MAIL THE COUPON.

THE LUNKENHEIMER CO.
"QUALITY"
CINCINNATI, OHIO, U.S.A.
NEW YORK CHICAGO BOSTON PITTSBURGH
SAN FRANCISCO NEW ORLEANS
LONDON
EXPORT DEPT. 129-135 LAFAYETTE ST., NEW YORK

THE LUNKENHEIMER CO.
"QUALITY"

P. O. Box 876 Cincinnati, Ohio

Gentlemen—Send me without obligation, copy of Gate Valve Book No. 511. HJ

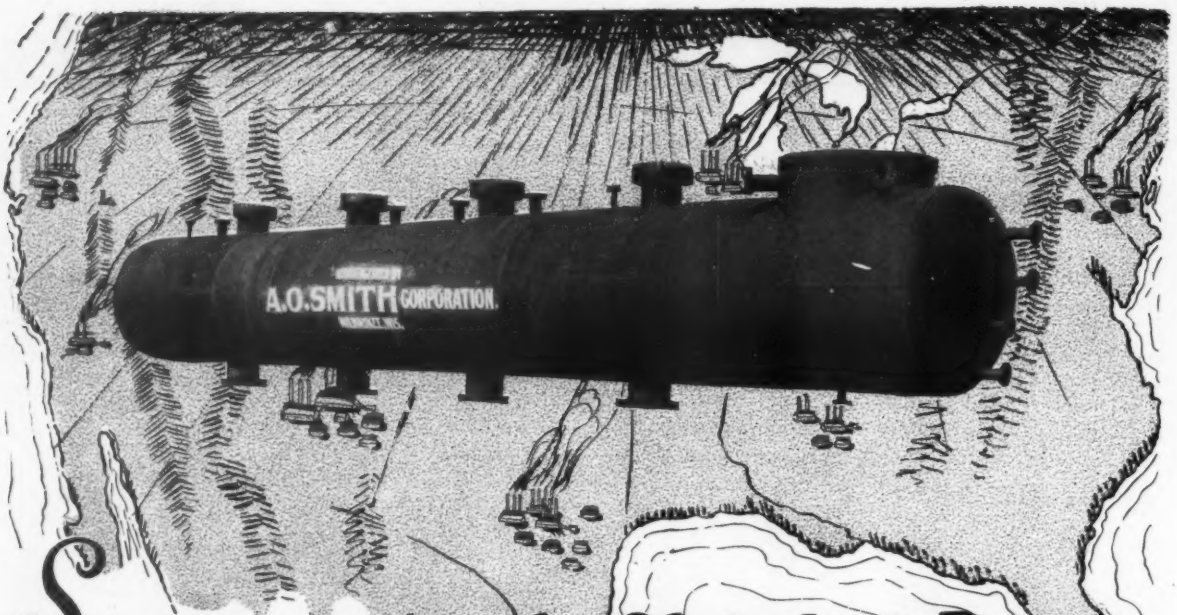
Name_____

Firm_____

Position_____

Address_____

6-47-89



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The World's Largest Cracking Still

The Smithsteel Cracking Still shown above is the world's largest pressure vessel. It is 65 feet long, 8 feet in diameter and weighs 268,800 pounds. The wall thickness is 3½ inches. It was completed July 15, 1926.

Wherever petroleum is refined—Gulf Coastal, Mid-Continent, Pennsylvania and in a score of refining centers scattered throughout the whole United States—there are found Smithsteel Cracking Stills.

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The three largest pressure vessels in the world bear the A. O. Smith name. The refining industry is using Smithsteel Cracking Stills by the hundreds in the making of better, cheaper petroleum products. The results obtained with these vessels are worth an investigation.

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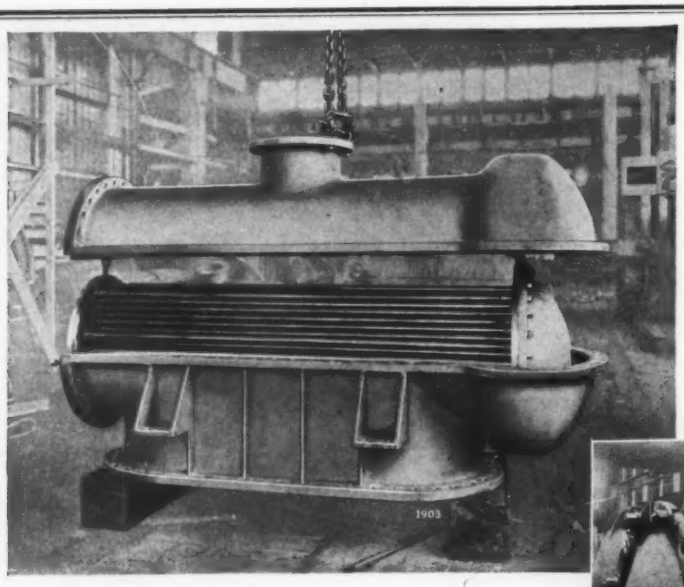
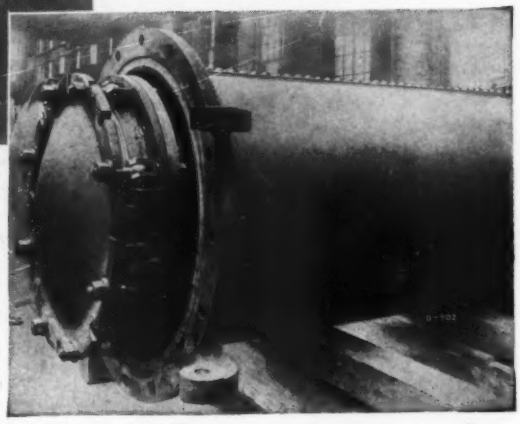


Fig. 1—Heater with removable tube bundle and split shell.

Fig. 2—Quick opening head for Heat Exchanger.



Labor Savers

Some oils are corrosive--others are dirty

In either case the tubes of heat exchangers, partial condensers and similar apparatus must be frequently inspected, cleaned and perhaps renewed. Where the oil is dirty or corrosive, special designs are offered by the Wheeler Condenser & Engineering Company to render cleaning and repairs easy. A few of these are illustrated on this page. Fig. 1 shows a design for use with corrosive vapors or liquids. The tube bundle is removable for ready replacement of tubes. No space is needed at the end of the shell for drawing the tube bundle. The shell is form fitting so that the liquid or vapors on the outside of the tube are forced in contact with them and cannot bypass around the tube bundle. Fig. 2 shows a heat exchanger with hinged tube head covers making access to the interior of the tubes easy. This design is used where the oil contains suspended carbon and the tubes require frequent cleaning. It is also employed in condensers and coolers where dirty circulating water must be used.

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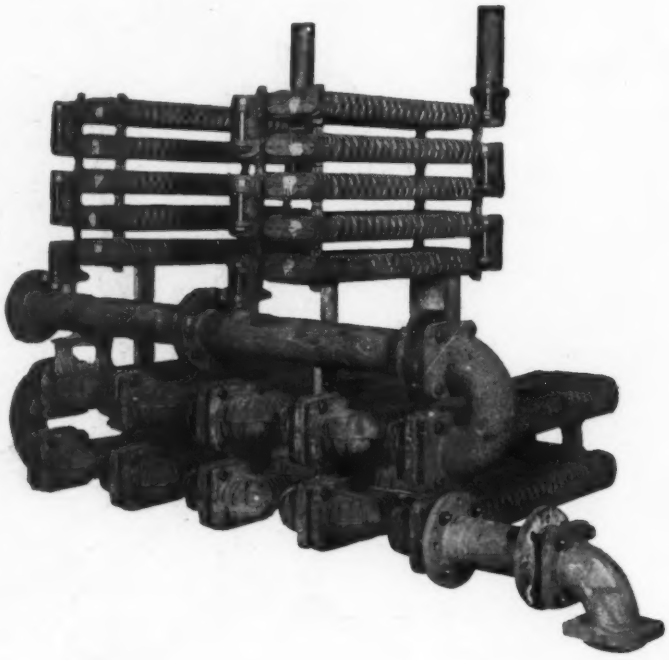

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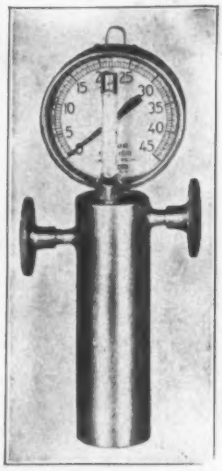

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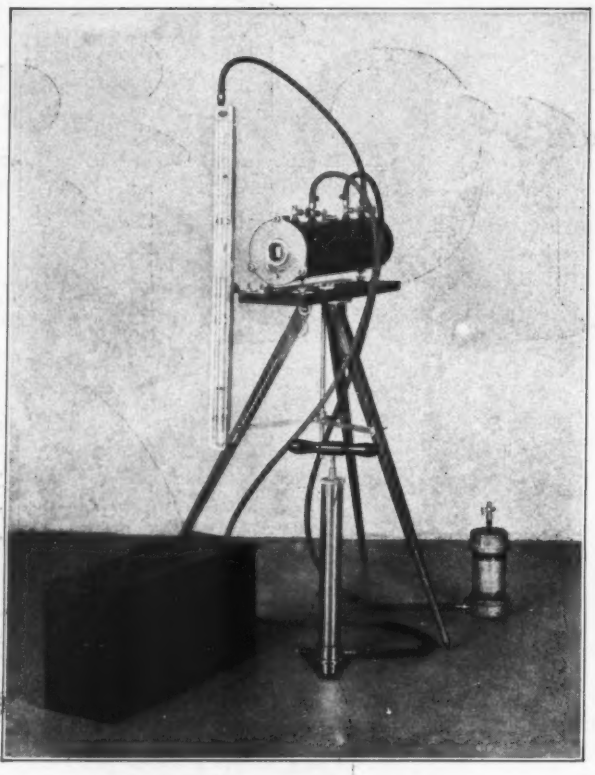

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More -Power to You- in 1927!

A hundred and sixty-five horsepower wish from the home of

Clark Compressors and Drilling Engines

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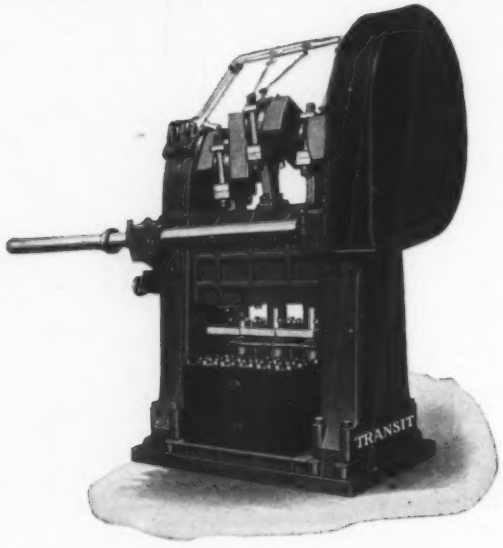
A NEW TYPE
—of—
HOT OIL PUMP



Here is a pump with which you should be familiar. It is a TRANSIT 6 x 12″ Vertical Triplex Power Pump for pumping hot oil up to 750° F., and to 1050 lbs. working pressure. Normal capacity 170 barrels per hour.

This type of pump has many advantages not found in other types for this important work:

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2. The weight of the fluid plungers is suspended vertically from the crankshaft, thus relieving the packing of this weight. Result: long wearing packing and long wearing plungers.

3. A valuable feature is the very fact that it is a triplex. Three fluid cylinders insure that pulsation is reduced to the minimum, and a very uniform speed of hot oil through the cracking coils is obtained.

4. Each stroke of a power pump, pumps so much every time. This means an exact capacity per minute, per hour, and per day. In other words, the capacity is unvarying.

The power or drive portion of this pump is very strong, and is similar to our tried out designs which have been operating in heavy pipe line service for years. A broad faced herringbone gear of cast steel, and a pinion of forged steel eliminates practically all gear noise and vibration.

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The fluid plunger stuffing boxes are extra long, water cooled, and fitted with two sets of packing and a lantern gland. With this arrangement no stuffing box leaks are possible.

Prints, photographs and detailed description on request

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Vol. 6, No 1. JANUARY, 1927

The REFINER
AND NATURAL GASOLINE MANUFACTURER

Edited Monthly at Tulsa, Oklahoma GRADY TRIPLETT, *Editor*

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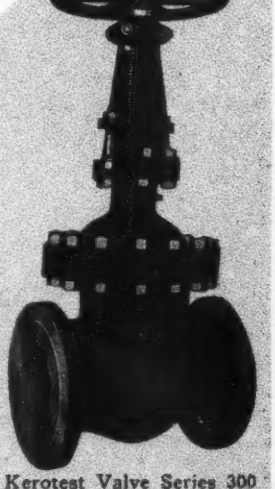
Series 150—150 lbs. pressure at 750°
Series 250—250 lbs. pressure at 750°
Series 300—300 lbs. pressure at 750°
Series 400—400 lbs. pressure at 750°
Series 600—600 lbs. pressure at 750°
Series 900—900 lbs. pressure at 750°

Write for the Kerotest Folder



Kerotest Valve Series 300

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EDITORIAL COMMENT

Another Point

RECENTLY there has been a lot of talk concerning the relation of the car lot marketer and the refiner. Some of this talk has been of the public variety, some private. The latter class usually brings out some point not carried in the public utterances.

Now here is a point out of some of the private talk. It concerns the inclination of the marketer to speculate on a rising market. He begins buying gasoline when he figures a low price level has been reached.

If the price advances, his opportunity for profit taking increases proportionately. So he can sell his speculative holdings just a bit under the price refiners are asking. When the car lot marketer does that he is a harmful factor in the gasoline market.

That sort of thing happens often enough to make it a point worth considering. Refiners know of the condition but they hesitated to say it in public.

There is another side to the picture. Gasoline bought in the hope of higher prices, often runs into a still lower market. Then the car lot marketer loses. Not a few have closed shop from such losses.

When the car lot marketer loses, the refiner is not helped. The jobber may be temporarily, as well as the customer. But business failures are a costly thing to any business and the users of gasoline pay those losses somewhere along the line.

In the public utterances on the matter of relationship of the refiner and the car lot marketer, the marketer has been praised when he held to the principle of doing business on a commission. On that score he is a helpful factor to the pertoleum business.

All of which just raises a point but does not settle anything.

Worth Nothing

"DIESEL driven automobiles which will travel fifty miles on a gallon of crude oil costing five cents were predicted yesterday by Diesel engine experts at a session of the forty-seventh annual meeting of the Oil & Gas Power Division of the American Society of Mechanical Engineers in New York City."

The quotation is from the Daily Oil Digest of the American Petroleum Institute, being taken from the New York World.

This is not any time to grow panicky about gasoline as a motor fuel. But the question of providing fuel for the automobiles of the world is not concerned solely with the reserve of crude oil. Automotive engineers will have a word to say about it.

One Day for Refiners

FOR its next convention the Western Petroleum Refiners Association will confine its program to one day, March 3, 1927.

The place for the meeting will be determined by a vote of the membership, now being taken by mail. Three cities have been left to the voting, Tulsa, Kansas City and Chicago.

The decision to have a program for one day is part of a system of enlarged activity, which will see six or eight group meetings held during the year in different cities within the Mid-Continent area. Half of these group meetings will be devoted to technical programs and half to programs for executives, sales managers and credit managers.

The one-day convention will be purely an affair for executives of the concerns making up the association membership. The plan is to have but one assemblage of the convention. It will begin in the morning, lunch will be served to break the program for a short time, when the business of the day will be continued and finished.

Executives are being urged to attend this program and to push the program so all business can be completed in the one day.

The first of the technical group meetings for this year will be held January 17 and 18, in Wichita Falls, During the meeting of the American Petroleum Institute here December 7, 8 and 9, the technical committee of the Western Petroleum Refiners Association made plans for the program, which will be issued soon.

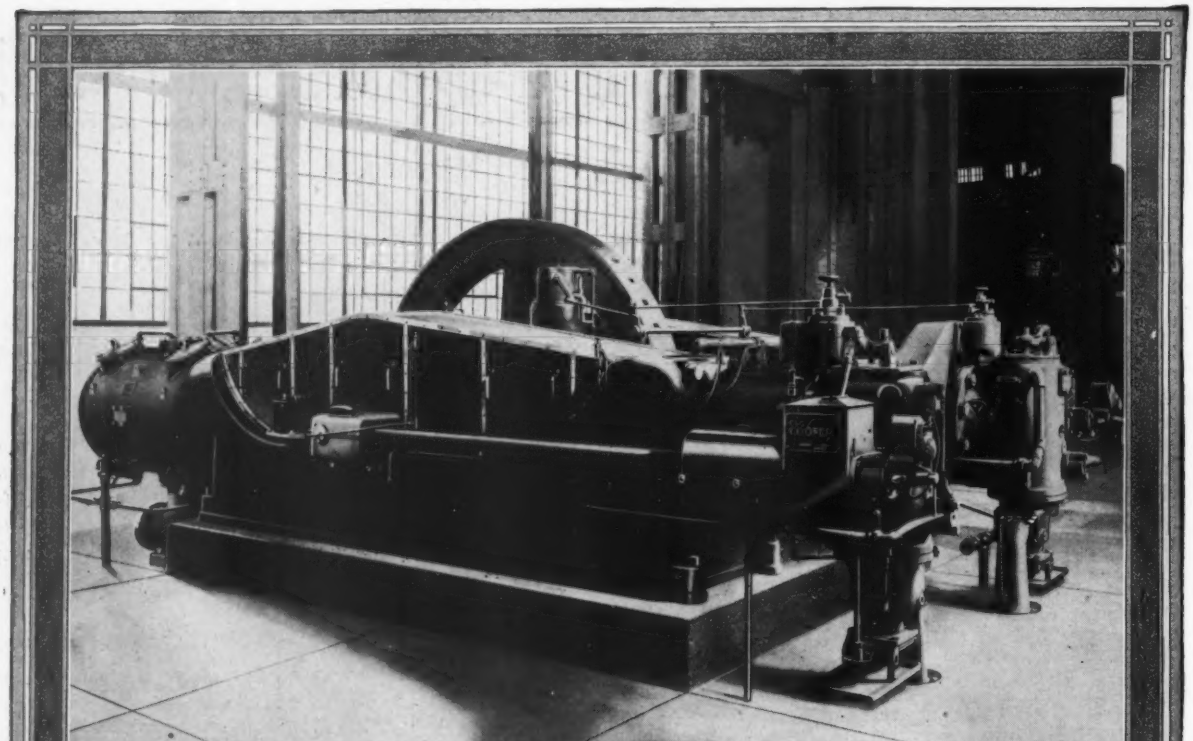
Manufacturers to Meet in April

DATES for the 1927 convention of the Association of Natural Gasoline Manufacturers have been set tentatively for April 19, 20 and 21 in Tulsa.

First conventions were for three days. Recently, however, two days have been given to the program. For next year the program will continue three days.

This is to allow more time for discussion of the subjects, rather than to increase the length of the program. At the 1926 convention, some of the sessions had to be ended before discussion had been completed, due to lack of time.

WITH 62-64 gravity gasoline crowding the U. S. Motor specification product for the top place in the gasoline ladder, natural gasoline is coming into high favor. Natural gasoline manufacturers of the Mid-Continent area are shipping to the Mountain States and to other territories of long haul.



"I can key up the bearings on a Cooper in ten minutes."
"You mean a single 85 horsepower engine?"

"No, I mean a twin 170 horsepower unit, and all the help I want is a man to hand me the wrenches. I have done it and I have a standing bet that I can do it again whenever the occasion requires."

This Cooper enthusiast is field foreman for one of the larger oil companies in the Mid-Continent field which has recently begun to use Cooper engines. Such records emphasize the extreme accessibility of Cooper engines. Operators always like them because they are so much easier to keep on the load, while the company officials like them because they actually show greater production at a lower cost.

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Trend in California Absorption Practice Is to Efficiency

Producers have awakened to the fact that natural gas is far too important to be considered as a mere by-product

By PAUL BARTON

CONTINUAL striving for higher efficiency has been the keynote for development of the California natural gasoline industry to its present very high standard. Two most apparent contributing factors responsible for this development are, first, payment of royalties to the producer on actual net sales of gasoline and residue gas rather than on any specific gas test; and second, intense competitive conditions arising out of "town lot" drilling.

In general, efficiency of an industry is no better than efficiency of its testing practice. This is doubly true of the natural gasoline industry which deals in hidden values occurring in an invisible medium—gas. The natural gas engineer must depend almost entirely on results obtained by his tests for the basis of process development and refinement in equipment design. Thus, developmental history of the natural gasoline industry is very closely bound up with progress of efficiency in gas testing.

Unfortunately, there is no standard of reference for the term "plant efficiency." In general engineering practice, of course, an efficiency of 100 per cent is an ideal based on definite knowledge of energy or matter. But efficiency of a natural gasoline plant is based on results of an empirical testing method, plant production being compared to content of the gas as shown by tests. It is only human that an engineer responsible for performance of a plant should strive to make apparent efficiency of his plant approach 100 per cent. The term "apparent efficiency" is used advisedly. Even at present, when many engineers believe the limit of extraction efficiency to be almost reached in California practice, a definite standard for comparison is wanting. Even though some empirical test should become accepted as a standard, just as long as that test depends upon the relationship of partial pressures of various constituents in the gas for its result, efficiency of that test will vary with the chemical constitution of the gas.

The freedom of the California natural gasoline industry from contract limitations on testing practice, insofar as royalty settlement is concerned, has encouraged an intense interest in the chemistry and physics of the absorption process and their practical applications. The direct result of this interest has been a gradual changing of plant and equipment design and of operating conditions as well. These changes are making themselves felt.

"The trend of California Absorption Practice" marks the beginning of a series of papers prepared exclusively for The Refiner and Natural Gasoline Manufacturer by one of the best known, keenest students of the game on the Pacific Coast. Paul Barton, the author, is president of the California Natural Gasoline Association and senior member of the firm of Barton, Manning and Warner, of Alhambra, California. He speaks with an authority recognized and lauded by those who have had the privilege of personal contact with the man in a professional way.

—Ed. Note

The Wet Gas Contract

Producers have awakened to the fact that natural gas is far too important to be considered as a mere by-product. Even those companies which do not operate absorption plants of their own maintain gas departments and often have a broader viewpoint of the industry itself than some of the larger self-contained companies. Therefore, the tendency of the producer is to be more and more exacting upon the operating company. This tendency does not, however, always work a hardship upon the latter, since royalties are paid on actual sales of gasoline from the plant, and improvements in equipment and operation which may increase the royalty returns to the producer likewise benefit the plant operator, to a greater degree in most cases. The direct result of this growing knowledge of the producer is that most contracts being written are for definite and usually short terms. Contracts "for life of the lease" are a distinct rarity.

So-called "dry" or residue gas resulting from treatment of wet gas for extraction of gasoline has been receiving a lot of attention from both producer and operator. It is rapidly taking on the aspect of a separate and distinct commodity. It is becoming more and more rigidly accounted for.* The rapidly growing practice of producing deep wells by "flowing" with compressed gas has also greatly accentuated necessity for strict residue-gas accounting.

The Absorption Plant

The outstanding feature of the development of the California oil absorption plant is the great overload capacity of various units without appreciable falling off in efficiency. This is due mainly to the careful design of individual parts of the plant. Probably the greatest single lesson learned by California natural gas engineers during the hectic period of building and rebuilding of plants, covering the past three or four years, is that each individual part of a plant, wherever possible, must have a capacity range correlated to capacity ranges of every other part. This involves a very complicated consideration of gas and oil pressure losses, heat transfer rates, construction economy, and many other interlocking factors.

Besides the development of the highly flexible operating unit, extreme changes of capacity have evolved a more complex type of plant allowing for additions of complete units or for increasing capacity of plant members operating in battery. It is easily seen that the portable plant idea is a natural outgrowth of this development. The "big brother" of Portable, which has recently made its appearance, is the latest example of the flexible unit type of construction described above. Figure 1 is a typical curve for a small single unit absorption plant in one of the Los Angeles Basin fields and illustrates admirably the rapidly fluctuating conditions which must be met in operation of such a plant.

The Product

Natural gasoline in California has been a more or less nondescript commodity, established grades or specifications being practically unknown. This condition is easily understood when it is considered that the greater portion of natural gasoline production

*A method for completely accounting for every cubic foot of natural gas taken into a plant, in regard to both gasoline and residue gas is given in a paper by the writer entitled "A Natural Gas Record and Accounting System," Petroleum World, July, 1926, pp 46-48

is owned by refining companies themselves. Most of the balance is sold on long time contracts, specifications being a matter of agreement between buyer and seller only. These few specifications usually are rather flexible, taking the form of limitations. Thus, 380 degrees F. is a common upper limit for the end point (by Bureau of Mines distillation), 72 degrees A. P. I. is the usual lower limit of gravity. Only recently has vapor pressure and distillation recovery been given much attention. The question of stability has been slow to receive consideration on account of two general conditions: First, the greater part of production has been derived from low-pressure (30 pounds per square inch gage) oil absorption plants the product being characteristically more stable than gasoline from other types of plants; and, second, favorable location of plants with respect to refining centers permits pipeline deliveries and obviates storage at the plant. However, increasnig efficiency of the low-pressure plants in conjunction with the growing use of recompressor systems for recovery of lighter fractions is giving rise to a distinct problem. Already two of the larger companies have adopted stabilization.

Handling

Storage of natural gasoline in plants has been reduced to an almost negligible quantity. In fact the average for all plants in California, as shown by Department of Commerce monthly reports, is in the order of a single day's production. In most cases, shipment is made daily, gasoline being sold on contract. Even so, great care is taken to prevent loss in handling. One company has systematized its handling to the point where actual monthly loss between plant and refinery tanks is less than one per cent. It is almost universal practice to store plant production in pressure tanks, maintaining a pressure of ten or fifteen pounds per square inch.

Vapor Recovery

Recovery of vapors from crude oil run-tanks in the field has received most attention from those companies treating their own gas. Smaller, independent producers, have in most cases neglected this item and are hesitant in going into it because of difficulty of adapting their equipment to requirements of a vapor recovery system. In the case of the independent natural gasoline manufacturer, cost of installing a dual gas-gathering system together with unwillingness of the average producer to furnish proper tanks and auxiliary equipment, has so far prevented growth of this very valuable side of the industry. Of course, all larger refineries and tank farms are fully equipped for conservation.

Use of Vacuum

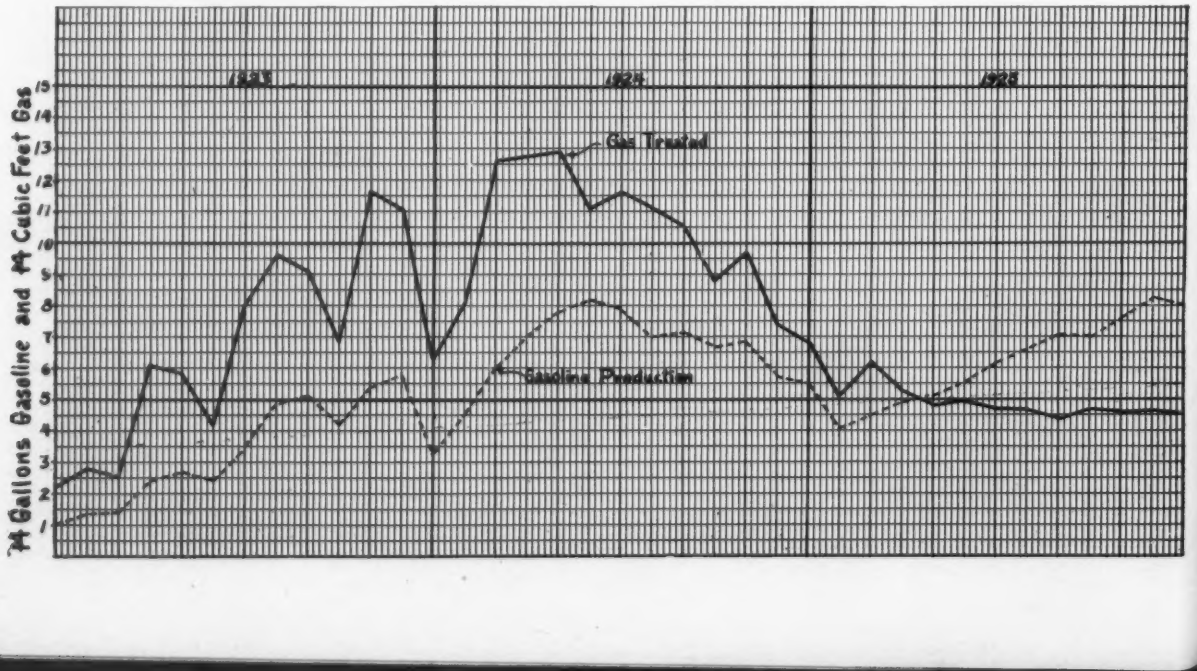
Practically all California natural gasoline plants operate compressors for gathering gas from wells. In most cases a vacuum of from five to fifteen inches of mercury is maintained at the plant. Vacuum regulators are placed near individual oil and gas separators at the wells to safeguard against pulling a vacuum upon the well itself. In some cases, separators are elevated so as to allow oil to gravitate into run-tanks, thus permitting a slight vacuum upon the oil in the separator. But this latter is not general practice. There is a very strong sentiment among California producers against the use of vacuum in producing oil. Therefore, this tsource of increasing the enrichment of natural gas is at present nothing more than a mere future possibility so far as the California natural gasoline industry is concerned.

However, possibility of building up gas enrichment by saving field run-tank vapors has been proven and will go a long way toward compensating for lack of the other source. Thus, in one case in the writer's experience, a certain company built up its average recovery per thousand cubic feet of gas by means of a very complex tank-vapor system to a maximum of nearly six gallons in a field in which average recovery of all plants was less than two gallons.

Absence of the practice of carrying a vacuum upon wells obviates the necessity of installing equipment for obtaining very high vacuum (twenty-five to twenty-eight inches of mercury), so use in California of regular vacuum pumps is rare. Ordinary compressors are generally used, taking the gas in a single-stage compression from a moderate vacuum to about thirty pounds per square inch pressure. Treatment of gas at 30 pounds pressure is so common that it has almost become standard practice.

Stage Absorption

A recent interesting development in the California industry is building high pressure absorption plants for treatment of residue gas from thirty pound absorption plants after it has been compressed for transportation. Compression for transportation is generally done by the public utility company which has purchased residue gas for distribution. Residue gas from a number of plants is thus collected and combined, and although the gasoline content may be very low, the large total value and high pressure make possible successful operation of an absorption plant. Success of some of these plants has been so marked that it has stimulated research in low pressure absorption which has shown up in considerable increases in efficiency. It has given rise to the possibility of two stage absorption at low pressure, with utilization of specially designed equipment and different conditions of oil saturation, rates, etc., in second stage absorption.



Personal Equation Weak Point in Keeping Inventories

Executive supervision is required to insure proper accounting of all material entering into construction

By ALEXANDER B. MORRIS

IT is quite possible from a purely theoretical standpoint to maintain accounting records that will show in detail at any time what items have been purchased on investment accounts. On paper there is no reason why such accounts should not show correct inventory of all material used in the construction of any division of the plant. It is merely a matter of complete transfers and careful office work in making proper distribution of charges. It seems to be regarded in many quarters as an established fact that the investment account if analyzed will yield a very close inventory of material actually in place.

This attitude on the part of many company officials is the cause of some very irritating and costly friction between the field and the office. Nothing could be further from the truth in most cases than that a correct perpetual inventory of material in use can be maintained and the reasons for this apparent failure are to be sought not in imperfections in the accounting systems, not in inefficiency of the field force or the office staff, not in stubborness or unwillingness of the production and administrative branches to cooperate, but in failure of management to appreciate the psychological elements of the problems.

Executive Supervision Needed

It may be presumed to be worth while to preserve accurate records of disposition of material purchased for used in the field, since any organization spends a large part of its overhead in doing it. If so, it should be worth a small part of the attention of some executive to see that clear concise and unmistakable designations are placed upon the several plant units for which separate accounts are being kept, so that the men drawing the material from stock will not have to invent their own designations.

A man who is an excellent ditching foreman or connection foreman is seldom a master either of logic or English. His training and capabilities are generally not along those lines. His contract of employment does not require either. When he attempts to evolve an exclusive description for a piece of work and then attempts to frame that idea in words the result is seldom satisfactory to anyone. Certainly if he is a good foreman it would not satisfy him if he could step outside of his personal acquaintance with the work and read his description as it appears to a clerk having no knowledge of it. No two men will describe the same job in the same way if left to themselves. The same man will often vary his language in describing the same piece of work from day to day, to such a degree that any two descriptions will scarcely be recognizable as referring to the same thing.

For example let us say that we are laying a gasoline line from the Potts lease of the Jones Oil Company along the edge of our own Potts lease and Jones lease, using three-inch pipe from well to our Potts lease, and two-inch pipe from there to the end. At the same time we are laying a three-inch vacuum line on our Potts lease from the connection of the Jones Oil Company's gasoline plant. Material transfers and payroll items reach the office bearing the following:

Three-inch gas line on Potts lease.
Three-inch gas line on Jones Oil Company.
Two-inch line on west side of section 23.
Two-inch line on Potts lease.
Three-inch vacuum line to Jones.
Three-inch vacuum line on Potts.

Reader, take your choice. How would you group these charges if you did not know the field layout or who or what Potts, Jones, etc., are, other than names?

One Remedy

How to remedy this situation? One simple way would be to post in the warehouse a large scale map of the field. If these two pieces of work were authorized by separate work orders and by different job numbers, show on the map the location of the work and the job number applying to it; and require foremen and warehousemen to use the job numbers in drawing material rather than to permit them to use their own language in describing the work.

For companies who have instituted the plant ledger system for investment accounts, this basis of job designation may be expanded indefinitely and the original job numbers permanently used to describe the plant units. Then any work subsequently done in connection with or extension of the original job would bear the same number. Suppose, for instance, that three lines leave a gasoline plant yard. These could be shown on the map and referred to as 1, 2 and 3. Each branch off line 1 would 1.1, 1.2, 1.3, etc., and each branch off of line 2 could be numbered 2.1, 2.2, etc. Further branches or tributary lines could be similiarly numbered, as 1.2.1, 2.2.1, 2.3.2, 1.3.1, etc. As these are permanent designations of definite parts of the plant and as they correspond to permanent divisions of the investment account, any work done on any such line will always be properly described by the field force and properly distributed in the office.

Of what use are job analyses or of analyses of investment accounts? Frankly, the writer does not know, that is in the majority of cases. He has made many such analyses for various companies and never deduced any consistent information from them, except the fact that they are all very unreliable. Generally the results are so patently wide of truth that they are scrapped as useless. Many successful operators truly acknowledge their uselessness by making an attempt to segregate them in investment changes. This is true particularly of the smaller concerns. The writer knows of one gasoline company owning five plants, having a book value well in excess of $1,000,000, where the investment is not even divided by plants. This concern makes lots of money with a minimum of office work. It is in direct contrast to many other outfits who spend large sums annually keeping elaborate records with many subdivisions, some of which no more than approximate accuracy.

Experience Essential

Of course, if a job is being done for the account of someone else, to be paid for by them upon completion, the statement to the purchaser must be supported by bills or transfers correctly priced out. The record then obtained is presumed to be correct, and payment is made on this basis. If the work is turned in immediately after completion such statements are generally priced accurately, but if the construction job has been cleared into investment account and so carried for a year or two, an analysis at the end of that time will probably show many points of wide deviation from an inventory taken in the field. The sale of a part of a property which has been in operation for some time always should be made on a field inventory and the books adjusted on the basis of these findings, any difference being permitted to remain unadjusted or being charged to profit or loss.

Such an inventory in order to be accurate, should be taken by some one experienced in making clear and concise

notes, and having a good working knowledge of material, specifications and uses. With some forethought as to methods of procedure a complete word picture of the pieces of plant can be constructed. The purpose for which the inventory is to be used and the degree of accuracy required should be confided to the person who is to take it. This is important, since upon it he makes his judgment as how to proceed. A convenient set of conventional expressions or abbreviations should then be decided upon, and where any special group of fittings, for instance, well connections, or pumping equipment, are repeated several times, they should be detailed but once, and a note referring to this detail placed in the inventory for each well to which it properly applies. Engine houses, pump houses, boiler houses, etc., should also be inventoried in this way. Tanks and tank connections also lend themselves to this sort of handling. In this way many fittings are included in the inventory which otherwise would be lost sight of while the labor involved is little more than in measuring pipe without fittings.

Complete Descriptions Best

In inventoring the equipment of boiler houses, machine shops, compressor buildings and refineries great care should be exercised to obtain complete commercial as well as technical descriptions of various items, since types differing from each in some small detail only may differ widely in cost, and since in most cases it will be necessary to call upon the manufacturers for new prices for this material as of the valuation date.

For instance, boilers, especially when of the complex type, often found in large steam power plants, should be described as fully as possible, showing maker's name, serial number, type, indicated horsepower, size of furnace and grate-area, size and number of drums and thickness of plate, number and size of tubes and headers.

Notes for engine and compressor units should show make, type, drive, size of all cylinders, serial numbers, capacity, R. P. M. and any other information that can be obtained about them.

In machine shops where overhead transmission is used the length in feet of each size shafting, the number and size of all shaft hangers and the diameter and face of all pulleys should be taken. Pulleys are of steel and wood, split and solid and this should be shown as prices vary widely. The same attention to descriptive details with respect to pipe machines, planers, lathes, etc., is required as in the case of compressor, already noted. Material, width and ply of belting must be shown, and the footage of each class recorded separately.

Cooling coils in refineries or gasoline plants, scrubbers, absorbers or any pieces of equipment fabricated in the field from standard supplies should be described in full under separate captions, with sketches if necessary, so that the material in them will be identifiable with them in working up the notes.

Each Building Separate

Generally speaking it is advisable to list the equipment of each building separately. Outside equipment that is clearly a part of the building may be listed either with the inside equipment or by itself. Such a case is the circulating tank for cooling gas engines at a power house, which, while standing outside the building is undeniably a part of the equipment of that building.

Office End

So much for the field end of the investment account. The personal equation enters into the office end to at least as great an extent. In all the large companies the actual paper work is done directly by low salaried clerks, most of whom have never set foot in the field and have only the sketchiest sort of idea of most field practices. As to layouts, the physical relation of the element of plants they have no knowledge and no means of getting any. Even among the more energetic and interested of these, there is a lamentable ignorance in these matters, matters which are of very real importance if the office work is to be intelligently done.

Again management is to blame. Instead of affording to such of the office employes as may be interested whether through desire for useful information or through mere curiosity, the opportunity to learn more about their jobs, more about the real thing that the paper they handle represents, some office managers seem to do all in their power to keep these things secret. There may be some justification for their attitude, but the writer fails to see it.

One will frequently hear from men who have clerked in the accounting offices of large oil companies, say that the men are discouraged from taking any field experience. At least two instances have come to the writer's notice where young men holding white collar jobs have volunteered to spend their vacations without additional pay, doing some sort of light field work, and have been prevented from doing it, on the ground that they were supposed to spend their vacation in recreation rather than in work. Why two weeks spent in a field job would not be recreation to an office employee interested enough to want to spend his vacation that way, does not appear. To suppose that a man would not be benefited both physically and mentally by such a vacation is the height of short-sighted folly, yet at least two large accounting offices are now on that basis, and doubtless others are as well. The result is stagnation, loss of interest in the job and the company, and loss of value in personality on the part of the employe. From the point of view of the company it seems that though they may still obtain technically accurate balances in their books, the figures will have much less real meaning than if healthy curiosity were properly encouraged and satisfied.

The conclusion in general, is that there is too sharp a line drawn between the office and the field, so that there is not the ready flow of understanding and appreciation between the two that there should be. In particular, it is suggested that a little more brown collar work in the field for general office account will do away with more than enough of the unnecessary white collar work in the office to warrant the expense.

Refinery Team Second in Safety Contest

Tulsa, Oklahoma.—Teams from Mid-Continent refineries played a prominent part in the second annual Safety Contest of the Petroleum Safety Council of the Mid-Continent Oil and Gas Association.

The Empire team from Okmulgee came second in the judging, which was part of the program of the seventh annual meeting of the American Petroleum Institute. The Empire organization had three refinery teams in the contest, the Ponca City and the Cushing plants being represented as well as the Okmulgee team.

Other refinery teams were from the Barnsdall plant at Barnsdall, the Continental Refining Company at Sapulpa, Humble Oil & Refining Company, Baytown, Texas; Sinclair Refining Company, Coffeyville, Kansas; Skelly Oil Company, Eldorado, Kansas; Tidal Refining Company, Drumright; and Transcontinental Oil Company, Bristow.

Gravity Devices Being Tested by Committee

Tulsa, Oklahoma.—The gas testing committee of the Association of Natural Gasoline Manufacturers is now engaged in conducting a series of tests with various gravity balances and gravity bottles in order to recommend some acceptable standard method for determining the specific gravity of natural gas.

Investigations have so far been conducted in the laboratory of the Oklahoma Natural Gas Company. The several makes of balances and various types of bottles are being tried. Later these will be carried into the field for tests on both wet and dry gas.

A. J. Schlosser of the Barnsdall Oil Company is chairman of the committee. The laboratory tests have been conducted under the supervision of George P. Bunn, vice chairman of the committee, of the Phillips Petroleum Company.

Gasoline Test Changes Made by Committee

Tulsa, Oklahoma.—At its meeting here during the American Petroleum Institute sessions, Committee D-2 of the American Society for Testing Materials voted to instruct its representative on the Federal Specifications Board to vote for a change in specifications on U. S. Motor Gasoline to make the 90 per cent end point 396 degrees F. instead of the present figure of 392 degrees F.

Airplane view of Standard Oil Company's El Segundo Refinery

Warehouse Buys and Sells to Supply Plant with Equipment

Big stock at Standard's El Segundo Plant is accurately kept by simple methods and records

By GEORGE REID
Staff Representative

SINCE the initial installation of the Standard Oil Company's 5,000 barrel refinery at El Segundo, Calif., in 1911, the natural growth and development of the company's Southern California plant has resulted in the construction and present operation of the state's second largest refinery. The El Segundo plant is rated at 100,000 barrels capacity. The refinery site consists of 1200 acres.

The installation of modern scientific equipment throughout all departments of the refinery and in all phases of its operation has been atttended by the development of modern methods of control. The term control here not only applies to the regulation of operating systems in the actual refining of oil, but alludes to the direction of the numerous departments auxiliary to, and found in conjunction with the effective operation of a refinery of such magnitude.

Chief of importance among these associated departments necessary in their affiliation, to the smooth operation and maintenance of the refinery proper, is that of store-housing, warehousing or storekeeping. This division of storekeeping is of paramount importance chiefly for the reason that all other operating departments are dependant upon it for their uninterrupted service to the company. The realization of this fact was conducive to the formation and development of the storekeeping department by the Standard Oil Company of California at all of its plants.

Like a Retail Store

The accompanying airplane view of the El Segundo refinery illustrates the immense size of the Standard's Southern California refinery. The open territory just in front of the last still battery remains vacant to care for future expansion. Following the line of distillation units through the center of the plant grounds, then across the loading rack trackage, is found the large, commodius, concrete constructed storehouse.

This building is 100 feet in width by 200 feet in length and three stories in height. It is fireproof in construction, excellently lighted and ventilated by numerous windows.

Upon entering the building the visitor is pleasantly impressed by the orderliness of things. The systematic arrangement of steel cabinets for storing small items and the lack of confusion, disarray and disorder is striking. More than 8,000 individual or separate items are kept in stock in the storehouse and the arrangement is such that after a few hours training a novice could immediately deliver any one of the items called for. Practically all of the material in immediate demand, or that which is continually moving in and out of the storehouse, is filed on the first and second floors of the building. The material stored in the upper room, third floor, consists mostly of that which is seldom, or, not often, moving. The storehouse terms for material received and disseminated is "buying" and "selling", and in this manner the men employed in storehouse work assume the task of stock keeping with much the same attitude of the owner of a large mercantile store. This attitude lends itself effectively to the policy of keeping the required items on hand in the necessary amounts.

Materials Grouped

The thousands of items continually bought and sold by the storehouse are first segregated into certain groups. Thus the first group, and that which is probably most often handled consists of "bolts, nuts, screws and washers." This group is filed on the first floor and close to the entrance. All of this material is filed in steel cabinets in bins which are arranged in size, according to the amount of each particular item stored. The steel cabinet lends itself easily to the formation of numerous different sizes and types of bins. The steel bin has this advantage of flexibility over the bin of wood construction. The group of bolts, nuts, screws and washers further divided into filing groups of each of the items mentioned, and each of these smaller groups are filed alphabetically and in sequence as to size.

The next group consists of pipe fittings. All fittings for pipe work from one-eighth-inch up to four-inch are

likewise filed in steel cabinet bins, alphabetically and in the order of their size. To find a quarter-inch ell the storekeeper merely looks for the bin label E, then passing up the smaller fittings, promptly reaches into the right bin for the number required, makes a notation of the number of such fittings removed and the date of removal. Subtracting this number from the number of ¼-inch ells on hand, the inventory is complete and continuous. This illustrates the system of handling any or all of the 8000 items stored by the warehouse, and the result is a continuous inventory safeguarding against depletion of stocks.

A third group consists of shelf hardware and which cares for a large number of the usual items of that type. Tools form another grouping, and all material with which men work is classified in this division. Rubber boots, gas masks, shovels—in fact, all tools.

Inventory Perpetual

Another grouping is found embracing pump parts. In a series of cabinets are found any or all parts for any type of pump in operation on the plant yard. The storekeeper who "sells" a valve for a certain type of pump finds that all pump parts are filed in alphabetical order and also in the order of their size. Such storing of pump parts may appear somewhat difficult of attainment, but the system as employed by the Standard Oil Company has simplified the filing nicely. The storekeeper, however, upon entering the removal of the pump valve upon the card at the bin may find that the stock on hand has reached a predetermined minimum and that more of such stock must be "bought." He then removes that card and inserts another, giving the date and amount of stock on hand in that particular bin. The card removed is placed in a basket and dispatched to the chief storehouseman, who notes the inventory and immediately places a requisition for a number of valves to replenish the stock. Both the minimum number of items to carry in stock, and the number of such items to be purchased when the stock reaches the minimum inventory have been predetermined by experience over a period of years. The storekeeper has taken into consideration the number of each one of the 8000 items that the plant has required for a period of three months during the years of its operation. Thus the stock is not permitted to fall below a 90 days supply of any one item. Consideration has also been given to the availability of any particular item, the time required to buy and receive such items, and this factor influences the minimum inventory quantity. Thus each day, the chief of the storekeeping department receives the cards from the "store" which state just what items and how much must be immediately purchased in order that the store may avoid delaying any particular work on the plant yard.

Valves and valve fittings or parts form another group. Sizes from one-eight-inch to four-inch are stocked in steel cabinets and the larger valves, up to ten-inch, are carried on the concrete floor of the warehouse. Such large articles are all stored inside of certain painted lines, marking the amount of space required by each item for the maximum inventory.

Tank appurtenances form another group—special breather valves, hatches for gauging, and specialized fittings, etc., enter this group. All of the acid plant materials, special metal valves and fittings, lead in various shapes, and everything especially devised for the acid plant are filed together in a separate group.

Hose, forms another. Regardless of its use or application, all hose is grouped together. Electrical equipment, is embraced in a separate group, and a large section of the second floor of the building is given over to all types of large or small electrical equipment, supplies and appliances, filed in the usual alphabetical order, and in the order of the size of the items.

Special Orders

Cable—Another group and grouped together. Machinery parts form a separate group, and spare parts, as experience has shown are required, are stored for all of the machinery in the shops and the refinery.

Laboratory materials form one group which consists mostly of glassware, but also embraces certain spare parts for some of the costly scientific apparatus employed in the testing and research departments.

Special material for some particular job, for some specific purpose, is not handled through the bins, but all of such material is received and handled through a separate section on the first floor of the building. This material is tagged showing its special dispensation, the job number, when required and so forth. In the event of a change in plans the storehouse absorbs any of this special material which is applicable to its usual routine of selling, and that which it can not absorb is returned for credit to the source of shipment.

The pipe and casing group is naturally stored outside of the building. The pipe yards can be seen around the warehouse and back of it in the illustration.

Paints, oil and inflammables are stored in a separate building, especially designed and constructed for the purpose of handling goods which for the most part, are received in barrels. Such material, however, as is found in the yards about the warehouse proper, are all marked with the stock number, inventory number, etc., with paint, just as the material in the building is handled. Cards covering the inventory of such material are kept inside of the building. These descriptive cards as employed maintain an automatic and perpetual inventory of all stock in the storehouse.

Since a great deal of floor space is utilized in the filing of the thousands of items in this monster warehouse, the movement of material is facilitated and expedited by the employment of three one-ton electric trucks. Two of there trucks are Elwell Parker Electric Company type, which have flat truck bodies. When material is ordered out of the warehouse in quantity, the storekeeper merely mounts the truck and drives to the various bins, gets his load and returns to the shipping platform. Material required from the second and third floors is reached by an electric elevator large enough to accommodate the trucks employed. The third truck is Automatic Transportation Company crane type, designed for handling heavy valves and fittings. The crane hoist is driven by electricity and it is merely necessary to drive up to the heavy fitting desired, tie to it with chains and lift it clear for removal to the waiting delivery truck at the door. In this manner the movement of very heavy material from the warehouse is accomplished with both ease and speed.

Trucks on Schedule

No one is allowed inside of the stock rooms proper, except those actually employed in the delivery of materials. The mechanic is not permitted to visit the storehouse to gather material except in cases where delivery is urgent. To avoid the usual influx of employees from all over the plant the storehouse delivers all material required to any part of the plant by automotive truck. This truck makes hourly deliveries throughout the entire plant, and all material desired at any point in the yard is requisitioned by telephone. Fully 90 per cent of all of the items disseminated is handled in this manner. Special or hurry up orders are carried to the job by storehouse employees on bicycles, of which the storehouse has four. But such delivery is the exception rather than the rule, for shop and labor foremen are able to anticipate their wants an hour in advance, and by so doing they receive their material by truck delivery from the storehouse.

Most of the material purchased by the Standard Oil Company is bought on specifications as determined by its Specification or Material Testing Division. All of the material purchased by the company is inspected and certified by employees of this department before it enters the storeroom for "selling" to the plant. Materials must be standard and meeting specifications of both the manufacturer and the company before they are accepted by this department. Such items as thermometers and hydrometers and kindred supplies are checked against certain standard certified instruments upon receipt and any faulty material is rejected.

The company has also developed a

(Continued on Page 96.)

Average Depreciation of Refinery and Gasoline Equipment

For accounting purposes some basis must be arbitrarily fixed for estimating the term of usefulness of all items

By H. L. KAUFFMAN

"WHAT is the most nearly correct percentage depreciation of the various types of equipment used in the refining and natural gasoline industry?"

This is one of the most frequent questions in the minds of executives, and is given particular thought by the auditors and comptrollers of the various organizations engaged in these branches of the industry.

All who are interested in this subject think of three different factors in connection herewith. These important points are as follows:

1. How many years of useful life is possessed by the particular piece of equipment or unit?
2. What is the salvage value of that equipment or unit after it can no longer be actively operated?
3. What is the yearly depreciation of a particular piece of equipment or unit in use in the refining and natural gasoline industry?

In this article the rate of depreciation first will be discussed in a general way; that is, the percentage depreciation figures that will be given will be average figures, from such deviations can be made by an accountant as are necessary to meet some particular or unusual refinery condition. Thereafter, the exact depreciation percentages in use by one organization operating several different refineries in various parts of the country will be given. And, following that, will be given information relative to depreciation in the natural gasoline industry.

Refinery Equipment

Refinery equipment, which is necessary for converting the crude petroleum into finished, marketable petroleum products, may be classified (depending upon the type of refinery built and the period of time for which there is an assurance of a crude supply for the operation of the refinery) as follows:

1. Complete refinery of modern construction, equipped with a cracking plant and a plant for the manufacture of lubricating oils.
2. Skimming plant type of refinery, of modern construction, making only light oils and fuel oils.
3. Complete, modern refinery located in the Mid-Continent, Gulf-Coastal or Appalachian regions, and assured of a crude supply for the refinery during the life of the fields east of the Rocky Moutninn.wie etaoin un un un unaoi Mountains.
4. Complete refinery of average construction located in a region where it can obtain a crude supply for a period of time equal to or greater than the life of the refinery.
5. Complete refinery or skimming plant of poor construction, or similar types of plants located in a region where the refinery is not assured of a supply at least equal to or greater than the estimated life of the refinery.

The different units and equipment of a complete refinery, for convenience in discussion, may be grouped together in the following manner:

1. Distillation equipment: Stills, towers, condensers, heat exchangers, etc.; batch agitators and continuous treating plant equipment; also, absorption or compression gasoline plant equipment.
2. Cracking plant, complete.
3. All pipes and fittings.
4. Railroad sidings.
5. Boiler and power plants, including boiler, superheaters, engines, turbines, pumps, etc.; in fact, all boiler and power plant equipment.
6. Lubricating plant: Includes all equipment relating to the manufacture of lubricating oils and greases that has not been given any other classification, such as, percolation filters, contact filtration equipment, chilling machines, refrigeration equipment, Sharples dewaxing equipment, compounding and barrel house equipment, etc.
7. Buildings of all types.
8. Bleacher, run-down and field storage tanks.

Life of Equipment

No refinery equipment is given any salvage value at the end of its period of useful life.

All distillation and treating plant equipment, as well as absorption or compression gasoline plant equipment, has an average serviceable life of seven years. The yearly depreciation rate, therefore, is 14 2/7 per cent.

All cracking plant equipment, all pipes and fittings in use about the refinery and all railroad sidings are depreciated at the rate of 12½ per cent each year, since the length of their useful life is about 8 years.

All boiler and power plant equipment and all lubricating plant equipment is useful, on the average, for about 10 years. The depreciation rate on this class of equipment, therefore, is 10 per cent per year.

Buildings in a refinery of modern construction are usually of first-class construction, and are expected to have a useful life of at least 20 years. Consequently, the depreciation rate of well constructed buildings is low—only 5 per cent per year.

Tanks in a refinery, almost without exception, are of the above ground and permanent type.

Tanks of this general type may be divided into four, main, different groups as follows:

1. Steel tanks, having a capacity of from 5,000 to 55,000 barrels.
2. Steel tanks, having a capacity of from 2,500 to 5,000 barrels.
3. Galvanized iron tanks, having a capacity of from 500 to 5,000 barrels.
4. Galvanized iron tanks of less than 500 barrels capacity.

Tank Life

At the end of its years of useful life, no tank whatsoever is considered as having any salvage value.

Steel tanks of from 5,000 to 55,000 barrels capacity will have have an average life of 20 yeras, hence they are depreciated at the rate of 5 per cent each year.

Steel tanks, 2,500 to 5,000 barrels in capacity and galvanized iron tanks of from 500 to 5,000 barrels capacity—each will be useful for, approximately, 12 years. Hence their depreciation is considered as being 8 1/3 per cent per year.

Galvanized iron tanks of less than 500 barrels capacity are rated as being useful for eight years and are depreciated at the rate of 12½ per cent each year.

Modernly-built tank cars will have an average length of useful life of 20 years. They have no salvage value at the end of that time; and therefore, their yearly depreciation rate is only 5 per cent.

Under the heading of "Tankers and Accessory Equipment" are to be included:

1. Oil tankers (of modern construction).
2. Barges, tugs and small boats.
3. Docks and wharves.

None of this equipment has any salvage value.

Modern, well-constructed oil tankers will be serviceable for 20 years. Hence, they are depreciated at the rate of 5 per cent each year. Barges, tugs and boats of smaller size do not have a long period of useful life—only about 5 years; they, therefore, have a yearly depreciation rate of 20 per cent. Like-

wise, docks and wharves (as a general rule) do not prove useful very long—approximately 6 years—and hence 16 2/3 per cent each year is the rate at which they are depreciated.

As a whole, a complete refinery will show an average yearly depreciation rate of 10 per cent.

A skimming plant type of refinery of modern construction, making only light oils and fuel oils, is depreciated in accordance with the depreciation rates on similar types of equipment in use in a complete refinery.

A complete, modern refinery located in the Mid-Continent, Gulf-Coastal or Appalachian regions, and assured of a crude supply for the refinery during the life of the fields east of the Rocky Mountains, will have a long period of usefulness—at least, 20 years. A plant so located, therefore, depreciates at the rate of only 5 per cent each year.

Refinery Life

A complete refinery of average construction, located in a region where a crude supply can be obtained for a period of time equal to or greater than the life of the refinery, will have, approximately, a 10-year period of useful life, and hence shows a yearly depreciation rate of 10 per cent.

On the other hand, a complete refinery or skimming plant of poor construction, or a similar type of plant located in a region where the refinery is not assured of a crude supply for a period of years at least equal to or greater than the estimated life of the refinery, shows a high, yearly depreciation rate—16 2/3 per cent—since this type of plant can not be planned on to prove useful for longer than a 6-year period of time.

J. B. Rathbun (Petroleum Age, Issue of April 1, 1926, Page 59) gives slightly different percentage depreciation rates in a few cases from those given by the writer, and, primarily because he mentions specifically salvage and junk values that the writer does not give his table and comments on the depreciation of refinery plants and equipment are quoted below in full. The salvage and junk value of equipment, and how such accounts shall be handled is largely a matter of opinion as to how the accounts can be handled most simply and accurately.

The reader probably has noted that throughout this article attention was called by the writer to the fact that the refinery equipment under discussion was considered as having no "salvage value" at the end of the depreciation period. It is further to be noted, however, that, although at the end of the period of time mentioned the writer takes the attitude that the equipment possesses no so-called "salvage value" for the purpose for which it was purchased originally, it still may have an appreciably high junk value (an estimate as to the junk value of each piece of equipment was not given by the writer). One of the best methods of handling "junk value" account is to appraise the equipment as junk, charge the appraisal account, in which the equipment when new was carried, at the disposition price when that particular piece of junk equipment is sold.

Rathbun's table and comments on refinery depreciation follow:

"In the following table the depreciation, salvaging value and "junking" value are listed separately. By salvage, we understand the value remaining at the end of service in actual use. Junk value expresses the value of the metal sold as scrap, but not the value due to further service as repair parts or supplements to newer apparatus.

"Note—It is assumed in the above estimates that the plants are located east of the Rocky Mountains in an average climate, either inland or near fresh water. When near the ocean or where salt air can strike the iron work there will be greatly increased depreciation of the tanks, piping or structural steel due to corrosion. This same is true of plants located in very humid climate. A similar rapid depreciation will take place when the crude contains much sulphur, salt water or grit. Coal high in sulphur will affect the stills when coal is used.

"It is also assumed, except in one specially specified case, that the refineries are so located that a continuous supply of crude may be obtained during the life of the plant by trunk pipe lines. The limitation placed on the life of a refinery by the period of oil supply is, of course of the greatest importance.

"The junking or scrapping value depends much on the relation of the labor charge to the material charge and this, of course, varies with different classes of material. Thus in the case of a steam engine where the manufacturing labor is about 75 per cent of the total cost (including overhead), the scrapping value will be less than with rails where the greater part of the charge is in the material. With some machinery there are certain parts which can be used as replacements or in erecting new machines after the machine as a whole has ceased to function. This is salvage material. When the useful life of certain items falls to zero, taking the machine as a whole, some of the material may be salvaged, while on others a certain amount may be recovered from the junk. This is indicated in the last column to the right."

Actual Figures

The actual depreciation percentages on refinery equipment in use at the present time by one corporation operating several refineries are shown below. For convenience these are classified by the writer according to the rate of depreciation and then listing under each percentage rate all the refinery equipment that is depreciated according to that particular rate.

Table 1

Name or Location.	Useful life years	Depreciation per year Per Cent	Salvage value (replacement) Per Cent	Junk value (scrapped) Per Cent	Depreciation (yearly) minus Junk or salvage value Per Cent
Refinery Items—					
Buildings ..	20	5.00	0.00	5.00	4.75
Power plants, building and machinery	10	10.00	6.00	8.00	8.60
Railroad sidings	10	10.00	5.00	10.00	8.50
Electrical distribution	10	10.00	8.00	8.00	8.40
Docks, harbor improvements	8	12.50	0.00	0.00	12.50
Stills, condnesers, agitators, etc.	8	12.50	0.00	5.00	....
Piping, fittings, etc.	8	12.50	0.00	5.00	....
Lubricating oil filters, presses, chillers etc. ..	10	10.00	5.00	5.00	9.00
Tanks, loading racks, etc.	20	5.00	5.00	8.00	4.35
Complete Plants—					
Complete modern refineries of first-class construction served with pipe lines	20	15.00	6.00	8.00	4.30
Complete refineries of average conconstruction, served with trunk pipe lines ..	10	10.00	5.00	5.00	9.00
Complete refineries, cheap construction or located where supply of crude is not assured for the life of plant	7	14.28	5.00	5.00	....
Skimming plants, complete	6	16.66	5.00	6.00	....
Cracking plants, compelte	8	12.50	5.00	5.00	....

25 per cent yearly depreciation rate:

1. All steam hose in use around the refinery.
2. Furnaces, flues and chimneys, dephlegmators and expansion chambers of the pressure stills.
3. Gasoline crawler crane.

20 per cent yearly depreciation rate:

1. Locomotive.

15 per cent yearly depreciation rate:

1. Tools and supplies used around crude and rerun stills.
2. Pumps and heat exchangers at crude and rerun stills.
3. All pumps for general use.
4. Fuel oil heaters at pressure stills.
5. Air heaters at pressure stills.
6. Coke conveyor at pressure stills.
7. Pumps at pressure stills.
8. Hoists at pressure stills.
9. Motors at pressure stills.
10. Air compressors at treating plant.

(Continued on Page 88.)

Daily and Monthy Records Make Annual Inventory Easier

WITH the operation and maintenance of a plant engaged in the processing of crude petroleum one of the interesting problems that engages the attention of the auditing department and others is the plant inventory. The daily inventory, the monthly inventory and the inventory at the end of the year are inseparably linked together but there is a distinction between them that must not be overlooked. The daily inventory is usually simplified as much as possible giving consideration to such matters as crude in stock, crude runs, yields, fuel oil consumed and power generated with labor distribution, material bought and other incidentals which are solely concerned with the daily plant operation.

The monthly inventory or report of refinery operations covers more thoroughly the field of a complete plant analysis from crude runs to depreciation. From the monthly inventories the full year's report is made accurately and without an addition of office force or necessitating any unusual rush of work at that time. Too, the monthly inventory gives an insight into the financial side enough so that it is easily seen whether a balance is being maintained. whether the plant is making or losing money and pointing out with facts and figures the side that is making the profit and the one that is causing a loss.

The monthly report usually covers, Yields, Costs and Realizations with a separate heading for Products Manufactured and Values.—Anaiysis of Operating Expenses.—Charges to Stills. Under the head of Products Manufactured and Values comes,—Products.—Gasoline.—Barrels per day.—Percent of Charging Stock.—Value per barrel of Charging Stock. Naphtha.—Kerosene.—Kerosene Distillate.—Gas-Oil.—Benzine.—Topped Crude.—Fuel Oil.—Coke and Loss with each product listed separately. Under Analysis of Operating Expenses would come these items: Operating Labor.—Maintenance Labor.—Supervision.—Fuel Oil Consumed—Royalties Expended.—Operating Supplies.—Maintenance Supplies.—Chemicals.—Light and Power.—Liability Insurance.—Depreciation and Obsolete Material.—Insurance and Taxes and Office Expenses. Under the heading of Charges to Stills is found items such as Source of Charging Stock.—Designated Field.—Pipe Line Carrier.—Casinghead for Blends. Along with these is carried the Number of Barrels Received.—Daily Average.—Established Gravity.—Percent of Crude from Each Field and Well. Transportation Cost and Total Cost of Charging Stock at Stills.

Annual Inventory

The inventory at the end of the year then is more of a recapitulation. The year's end would find a complete analysis of the plant covering all phases from the initial investment in plant equipment to realizations from operation allowing for an average depreciation of 10 per cent in plant equipment for the year's operation. In completing the monthly inventory consideration is also given to vital subjects such as Gross Return of All Products Manufactured.—Net Gain or Loss per Barrel of Crude Run.—And Net Gain or Loss in Dollars per Day.

A conservative estimate of a 10 per cent depreciation in refinery equipment is an established average for a year's operation in a Mid-Continent refinery. However, where products are run containing high percentages of sulphur compounds and heavy oils and where steam power is generated from water high in scale forming compounds this average bill will vary upward. For instance the fractions distilled from heavy crudes containing over one per cent in sulphur in passing through the sytsem will have a high corrosive effect especially in the condenser coils and also in the towers. Where the boiler feed water is high in scale forming carbonates the coke if allowed to form in the boiler tubes will necessitate frequent replacement due to hot

Engineer's Report of Operation for 24 Hours Ending 7 A. M.——————1926

Total Stock on hand,	——————Bbls.
Stock Delivered	——————Bbls.
Charge Stock on hand,	——————Bbls.
Loss or long	——————Bbls.
Charge stock consumed	——————Bbls.
Still charges,	——————Bbls.
Through towers,	——————Bbls.
Total re-charge stock made in stills	——————Bbls.
Re-charge stock made in stills,	——————Bbls.
Benzine made,	——————Bbls.
Fuel oil residium made,	——————Bbls.
Refining Loss,	——————Bbls.
Benzine delivered to ——————	——————Bbls.
Fuel oil delivered to ——————	——————Bbls.
Recharge stock delivered to ——————	——————Bbls.
——————	——————Bbls.

RECAPITULATION

	Still Charges Barrels	Per Cent R. O.	Recoveries	Per Cent R. O.
Raw Oil to Stills				
Recharge stock to stills				
Benzine Recovery				
Fuel Oil Recovery				
Recharge Stock Recovery				
Refining Loss				

REMARKS:

Signed——————

spots. In cracking heavy oils the usual life of the furnace tubes is short. Ordinarily these must be replaced completely twice each year and sometimes more frequently. The high temperatures which refinery equipment is subjected to is constantly wearing down the resistance of brick installations and metal with which it comes in contact so that the average yearly depreciation of 10 per cent is a fair average.

Obsolete Equipment

Obsolete material and depreciation are in a sense synonymous. Plant material that no longer functions as it should or where it is seen that its use in connection with plant operation is causing a financial loss is usually discarded and counted with depreciation. Although this material may be in good mechanical condition for additional years of service the fact that it is no longer applicable to the situation, and other means are known which will replace it with profit, it is then replaced

When the time arrives at the end of the year for a complete plant inventory setting a basis on which to figure taxes, new insurance and plant re-alignment usually a plan is drawn up in order such as the following: Office Building, Equipment and Furniture.—Laboratory Building Equipment and Contents. — Warehouse Building, Equipment and Contents.—Crude and Steam Stills.—Condenser Boxes and Pipe Coils.—Machine Shop and Contents.—Pump House, Equipment and Contents.—Boiler House and Contents.—Water Wells and Equipment.—Electric Station and Equipment.—Steel Storage Tanks.—Other Tanks.—Gasoline Wagons, Pumps and Miscellaneous Material. Loading Rack and Switch Track. As was mentioned above much time is saved in completing these inventories and plant analysis by keeping the daily, and monthly inventories complete and up to date so that at the end of the year the auditing department will have a basis upon which to work.

MONTHLY INVENTORY OF REFINERY OPERATIONS

Yields, Costs and Realizations

Products Manufactured and Values	Yield Bbls. Per Day	Percent of Charging Stock	Value Per Unit
Gasoline			
Naphtha			
Kerosene			
Kero-Dist.			
Gas-Oil			
Benzine			
Topped Crude			
Fuel Oil			
Coke			
Loss			
Totals			

Analysis of Operating Expenses: Monthly Basis

OP. Labor	
M. Labor	
Supervision	
Fuel Oil	
Royalties	
OP. Supplies	
M. Material	
Chemicals	
Light and Power	
Insurance and Taxes	
Depreciation and Obsol.	
Office Expense	
Total	
Gross Returns All Prod.	
Net Gain or Loss per Bbl. of Crude run	
Net Gain or Loss $'s per Day	

Wichita Falls Plant Uses Panhandle Crude

Wichita Falls, Texas.—Texas Panhandle crude is being used by Reece S. Allen in operating the Miller Petroleum Company's 3000 barrel skimming and cracking plant at Wichita Falls. This plant was recently leased by Allen for a period of one year, with a short time cancellation clause in the contract, and the bulk of the crude supply is to be obtained from the Mid-West Exploration Company on contract.

Crude deliveries from the Mid-West's producing properties in the Hutchinson County section of the Texas Panhandle to the Wichita Falls plant are being made in tank cars, which are loaded at Mid-West's Borger rack.

Allen is the pioneer refiner of Panhandle crude, having erected the first plant in the Texas Panhandle at Amarillo during the early stages of the oil development in the district. This plant is being operated under the name of the Amarillo Refining Company with good success on the crude, and enjoying an especially good market for all fuel oil produced, account of the heavy demand of railroads serving Amarillo.

Taft, Calif.—Unusual interest was shown here November 15 at the first meeting of the Taft branch of the California Natural Gasoline Association in the work of that organization.

Among routine affairs of the meeting, R. E. Cameron of the Standard Gasoline Company was elected chairman of the Taft branch; M. H. Morgan, of the Lovell Gasoline Company, was elected assistant secretary in charge of Taft branch activities, and D. G. Geraldine of the Pan American was made a member of the state program committee.

December 4, 1925, membership of the association throughout the State of California was less than 20. Today, luncheons of the Los Angeles branch of the association are rarely attended by less than 120. A larger factor in the organization's growth is the excellency of material derived from open discussion at meetings.

Early in the history of the organization, the interest displayed in it came largely from individuals. At present, however, there is a marked tendency toward growing interest in the association on the part of operating corporations.

H. B. Earhart, president of the White Star Refining Company of West Virginia, operating the White Star refinery at Wood River, Illinois, announces the appointment of J. B. Edwards, at present in charge of operations at the refinery, to the position of vice-president and general manager. Mr. Edwards has had a long and varied experience in the oil industry, coming to White Star from the Tidewater Oil Company where he was manager of the Baytown refinery of Tidewater and a member of the board of directors of that company.

Manufacturing Stressed on A. P. I. Program

Committee named to formulate plans for co-ordinating technical activities of the industry

By GRADY TRIPLETT

Tulsa, Okla.—Petroleum refining and natural gasoline manufacturing came in for a greater share of the program of the seventh annual meeting of the American Petroleum Institute than at any previous meeting of the body.

The trend of the various activities of the Institute seems to be toward consideration of technical matters in its group meetings and this, no doubt, is responsible for the larger effort devoted to the manufacturing branch of the petroleum industry.

Sessions of the Institute began December 7, following a day of committee sessions, and closed December 9. While all activities of the Institue bear a relation to the manufacturing branch of the industry, no effort will be made here to report all accomplishments of the meeting. Only the outstanding general results and those specifically devoted to the manufacturing branch will be reported.

Resolutions

The resolution of the board of directors to seek legislation whereby the production of oil pools may be controlled through agreements was the most far reaching step ever undertaken by the Institute. The following statement on conservation measures was issued by the board of directors at its final session December 9:

"The Board of Directors of the American Petroleum Institute today had under consideration the preliminary report of the Federal Oil Conservation Board, consisting of Secretaries Work, Hoover, Davis and Wilbur.

"Two important and far-reaching resolutions in line with the recommendations of the conservation board were adopted by the Board of Directors of the Institute.

"One, that the prevention of the waste of gas is of paramount importance to the conservation and economical production of oil; and the other, approving in principle, agreements by producers having for their purpose the economical and orderly production of oil.

"On the vitally important question of waste of gas, the conservation board recommended, 'legislation with the declared purpose of conservation to stop waste of gas, the loss of its content of gasoline, and the even greater loss incident to reduction of gas pressure in the oil sands.

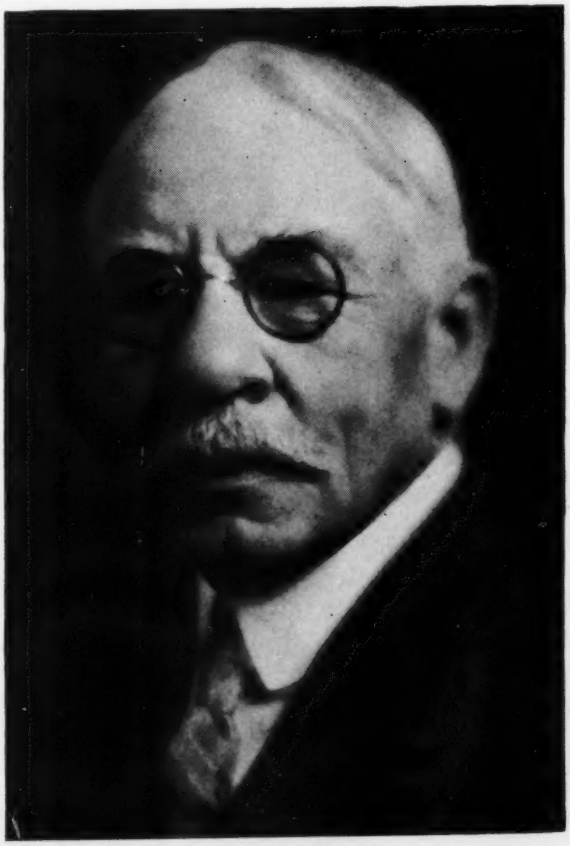
"The resolution of the directors of the Institute on this subject was as follows:

"Resolved, that we endorse the conclusion of the Federal Oil Conservation Board in its report of September, 1926, that the prevention of the waste of gas incident to the production of oil is of paramount importance in the conservation and economical production of oil, and the president of the Institute is requested to appoint a committee of seven to devise and suggest to this board or the executive committee such measures as will enable the industry, while continuing to meet the consumption requirements of petroleum and its products, to conserve in its natural state such reserves of petroleum as may not then be required for consumption."

Legislation

On the question of legislation to make possible agreements between producers in developing an oil pool, the directors passed the following resolution:

"Resolved, That the president of the Institute appoint a committee of seven to formulate and reocmmend to this board or its executive committee at the earliest practicable date a program of legislation, Federal and State, to be advocated by the Institute giving sanction and effect to agreements by oil producers for the curtailment of production in pools where and during periods when there is overproduction, having for their purpose the economical and orderly production of oil."



E. W. CLARK
President of the American Petroleum Institute

Following the passage of these resolutions, E. W. Clark of the Union Oil Company, Los Angeles, the newly elected president, named the following committee for the first of the resolutions: E. W. Marland, chairman, Marland Oil Company, Ponca City; Sid Keoughan, Continental Oil Company, Denver; Henry McGraw, Gypsy Oil Company, Tulsa; J. Edgar Pew, Sun Oil Company, Dallas; W. S. Farish, Humble Oil & Refining Company, Houston; L. P. St. Clair, Union Oil Company, Los Angeles; Thomas A. O'Donnell, California Petroleum Corporation, Los Angeles.

President Clark named the following committee to draft the legislative program: Amos L. Beaty, The Texas Company, New York, chairman; James A. Veasey, Carter Oil Company, Tulsa; C. B. Ames, Oklahoma City; John C. Townes, Humble Oil & Refining Company, Houston; A. L. Weil, General Petroleum Corporation, San Francisco; Axtell J. Byles, Tide Water Oil Company,

New York; F. C. Proctor, Gulf Production Co., Houston.

Technical Study

Bearing directly on the manufacturing branch of the industry was the movement begun for a study, looking toward the coordination of the technical activties within the whole oil industry. This was brought before the group meeting on Petroleum Refining and its products by Frank A. Howard, president of the Standard Development Company, who presented a paper, "The Relationship of the A. P. I. Technical Activities to Other Technical Society Activity."

After pointing out the many activities that exist in the effort of the several technical societies to keep pace with the technical trend within the petroleum industry, he said:

"Through many different channels the serious nature of this situation has come to the attention of the officers and staff of the American Petroleum Institute and an effort has been made by the president of the institute during the present sessions to secure the views and advice of a group of technical executives, nominated by the board of directors of the Institute.

"The organization and growth of the various scientific and technical societies which are now almost innumerable has been for the most part a spontaneous effort of the professions themselves to provide for their own members facilities for the dissemination of knowledge and experience, and for the making of personal contacts. On the part of the industries who employ the members of these professions, the support, and consistent support, by releasing their employees for purpose of attending society meetings and even paying their dues and traveling expenses, amounts to almost universal acceptance of the useful place of the technical society in the scheme of modern business. On the part of the petroleum industry this recognition and support has been generous."

Then he listed a number of societies, whose programs usually are devoted in part to the technical problems of the petroleum industry. These, he said, run the number of meetings that a man may desire to attend to such a number that the loss of time is serious, while attendance is expensive. After showing what the technical men of the petroleum industry had done and would continue to do toward cooperating with existing societies, he continued:

"But having done all of this we still find that our house is in disorder. Many suggestions have been made to me as to how to set it in order. These divide into two general lines: One is that we should invite our friends and relatives, the technical societies, to join us in the house cleaning. The other is that we should do it ourselves. It seems to me that the latter is the more reasonable course. If the time ever comes when it is necessary and feasible to attempt to define the relative spheres of activity of the learned societies and technical associations as between one another and the petroleum industry, that time is far distant. Until the petroleum industry has organized its own technical society work and made an assured success of such an organization, it would seem unnecessary to consider seriously the bogey of duplication of effort. It is not duplication of effort that is our trouble, but lack of effort.

"It seems clear to me, therefore, that our problem is one of building, not tearing down nor attempting now to co-ordinate.

"I do not feel that I can now offer any definite program for enlarged and better organized technical work, but for the reasons which have been given, a program should be outlined, and it should be based upon the principle of direct constructive effort by the petroleum industry, within and for itself, as the first step."

Associations Help

The Board of Directors of the Institute later named the following committee to study the problem of the future activity of the technical men of the petroleum industry: E. W. Isom, Sinclair Refining Company, chairman; R. E. Haylett, Union Oil Company of California; Ralph Holloran, Standard Oil Company of California; R. E. Wilson, Standard Oil Company of Indiana; K. G. McKenzie, The Texas Company; D. G. Delbridge, Atlantic Refining Company; E. DeGolyer, Amerada Petroleum Corporation.

Both the Western Petroleum Refiners Association and the National Petroleum Association cooperated with the Institute in the program of the group session of the evening of December 8, devoted to petroleum refining. Dr. G. G. Brown, representing the Association of Natural Gasoline Manufacturers, was on the program on motor fuels.

Considerable of the work of the group on uniform accounting within the oil industry was devoted to refining and natural gasoline manufacture.

The group session on safety methods dealt in part with the prevention of accidents around refineries and natural gasoline plant. Fire prevention, too, was a subject that touched frequently on the manufacturing branch of the industry. Transportation gave considerable to manufacturing.

The new president, E. W. Clark, was elected to succeed W. S. Farish, who served but one term.

William N. Davis of the Phillips Petroleum Company was reelected vice-president, representing production. L. L. Marcell of the White Eagle Oil & Refining Co., Kansas City, was elected vice-president, representing manufacture. R. D. Benson of the Tide Water Oil Company was re-elected vice-president, representing distribution.

Other offcials re-elected are Amos L. Beaty of The Texas Company, treasurer; R. L. Welch, general secretary and counsel; W. R. Boyd, Jr., assistant general secretary and counsel; Lacey Walker, assistant treasurer.

Committees Named

The executive committee is composed of the five officials, ex-officio, one retiring president, ex-officio, and the following: R. W. Stewart, Standard Oil Company of Indiana; George S. Davison, Gulf Oil Corporation; J. Edgar Pew, Sun Oil Company; H. L. Doherty, H. L. Doherty & Co.; Walter C. Teagle, Standard Oil Company of New Jersey; E. W. Marland, Marland Oil Company.

The membership committee is composed of J. F. Lucey, Lucey Petroleum Company; J. W. Van Dyke, Atlantic Refining Company; F. B. Henderson, Associated Oil Company; Frank B. Fretter, National Refining Company; Roy B. Jones, Panhandle Refining Company.

Directors re-elected are: L. P. St. Clair, Union Oil Company; F. H. Hillman, Standard Oil Company of California; Dave S. Ewing, Ethel D. Company; W. S. Farish, Humble Oil & Refining Company; H. R. Gallagher, Shell Company of California; Roy B. Jones, Panhandle Refining Company; R. D. Benson, Standard Oil Company of New Jersey; Edward Prizer, Vacuum Oil Company; K. R. Kingsbury, Standard Oil Company of California; Robert W. Stewart, Standard Oil Company of Indiana; Amos L. Beaty, The Texas Company; J. Howard Pew, The Sun Oil Company; F. B. Henderson, Associated Oil Company; W. G. Skelly, Skelly Oil Company; E. W. Marland, Marland Oil Company.

Directors elected for the first time are: Arthur F. Corwin, Standard Oil Company of New York; Frank B. Fretter, National Refining Company; S. C. Collins, Marland Refining Company; C. H. Kountz, Prairie Pipe Line Company; John Reid, Joseph Reid Gas Engine Company; S. A. Guiberson, Guiberson Corporation.

The board of directors voted to increase the number of directors to 60 and selected the following seven to complete the directorate: L. V. Nicholas, National Petroleum Marketers Association; W. S. Fitzpatrick, Prairie Oil & Gas Company; D. M. Folsom, San Francisco; E. R. Brown, Magnolia Petroleum Company; H. M. Dawes, Pure Oil Company, Taylor Alderdice, National Tube Company; John H. Markham, Jr., Tulsa.

Will Erect Absorption Plant at Oil City

Shreveport, La. — The natural gas production on the Louisiana Oil & Refining Corporation's property in Caddo Parish, near Oil City, has been contracted by Warren J. Anson, who maintained an office in the Brewster building, Shreveport, and an absorption plant will be erected shortly. A type "C" Newton process plant is being considered, and the natural gasoline production is expected to reach 3000 gallons daily, with surplus gas available for further plant expansion.

Enlarge Gasoline Plant at Bossier City

Shreveport, La.—The Louisiana Oil Refining Corporation is planning to supplement the natural gasoline plant unit now being operated on still gases at its Bossier City skimming and cracking plant.

Accounting System for the Natural Gasoline Department

With illustrative monthly statements presenting manufacturing costs and profit and loss results

*By GEO. F. WINTERS**
General Auditor, Phillips Petroleum Co.

THE natural gasoline industry has grown to such proportions during the last decade that most of the major producing oil companies now have a natural gasoline department. The operation of natural gasoline plants is not confined to the major oil companies for it is not uncommon to find such plants owned and operated by small corporations or even individuals. A few corporations have built up large organizations by devoting all of their activities to the production and sale of natural gasoline.

In this article, it is considered unnecessary to include a discussion of the current asset, current liability, reserve, capital and surplus accounts, about which so much has already been written. The Trading Account, Marketing Expense, Gasoline Plant Opermarketing expense, (5) net profit, (6) accounts appropriate for the use of the natural gasoline department, are discussed herein with illustrative statements presenting manufacturing cost and profits and loss results.

The aecounting period for the natural gasoline industry, so far as operating results are concerned, is the calendar month and each plant is considered on operating unit. Provision should be made in the account classification for a complete record of the capital and working assets as well as the income and expense accounts for each plant. The profit and loss and manufacturing statements should be prepared monthly.

A typical profit and loss statement for a plant (Statement 1) and a statement of manufacturing cost (Statement 2) showing the per gallon cost of each operating account are presented. A summary of the profit and loss results of all plants of the company (Statement 3) shows in comparative form the (1) sales, (2) cost of gasoline sold, (3) gross profits, (4) marketing expense, (5) net profit, (6) number of gallons sold, and (7) net profit per gallon, together with these operating results reduced to a "per gallon" basis.

Chart of Accounts

I. Trading Accounts:
   1. Gasoline Sales
   2. Gasoline Inventory
   3. Gasoline and Naptha Purchases

II. Marketing Expense Accounts:
   1. Tank Car Rentals
   2. Office Salaries
   3. Office Expense
   4. Advertising
   5. Discount allowed
   6. Outages and allowances
   7. Traveling Expense
   8. General Office Overhead
   9. Miscellaneous

III. Gasoline Plant Operating Accounts:
   1. Gas Purchases
   2. Absorption Medium
   3. Operating Labor
   4. Special Labor
   5. Repairs
   6. Supplies
   7. Fuel
   8. Water
   9. Lubricating Oil
   10. Treating
   11. Electric Power
   12. Taxes
   13. Insurance
   14. Autombile Expense
   15. Office and Laboratory Expense
   16. Depreciation
   17. General Office Overhead
   18. Miscellaneous
   19. Residue Gas Sales (Credit)

IV. Plant and Equipment:
   1. Engines and Compressors
   2. Pipe
   3. Tanks
   4. Boilers
   5. Pumps
   6. Fittings
   7. Electric Equipment
   8. Recording and Indicating Instruments
   9. Office and Laboratory Equipment
   10. Other Equipment
   11. Buildings
   12. Masonry Construction
   13. Labor
   14. Freight and Hauling
   15. Miscellaneous
   16. Casinghead Gas Contracts

Trading Accounts

1. Gasoline Sales:—A general ledger account should be credited with the invoice value of all gasoline sales for the accounting period. The gasoline sales account is the controling account of the subsidiary analysis record of gasoline sales. The subsidiary record may contain separate accounts for each gasoline plant, showing the number of gallons sold and the invoice value of sales, or it may be a columnar record showing the total gasoline sales with plant distribution made thereon. A complete record of the sales should be kept showing the gallons and the sales value of all gasoline shipments made from each plant.

The balance of this account should be closed into the profit and loss account at the end of the accounting period.

2. Gasoline Inventory:— To this account should be charged the cost value of the gasoline inventory at the time of the closing of the books. For statement purposes, a memorandum should be made in the account of the number of gallons of gasoline on hand. The value of the inventory is concurrently credited to the profit and loss account.

The balance of the account will be closed into the profit and loss account in the succeeding accounting period at the time of closing the books.

3. Gasoline and Naphtha Purchases:— To this account should be charged the invoice purchase price, transportation and delivery charges, of all gasoline and naphtha purchased. The number of gallons purchased should also be recorded in the account.

The balance of this account should be closed into the profit and loss account at the end of the accounting period.

Marketing Expense

The total marketing expense for the accounting period may be recorded in a single general ledger controlling account with subsidiary analyses, in which are recorded, for each plant, the marketing expenses classified according to the following account specifications:

II. Marketing Expense:
   1. Tank Car Rentals
   2. Office Salaries
   3. Office Expense
   4. Advertising
   5. Discount Allowed
   6. Outages and Allowances
   7. Traveling Expense
   8. General Office Overhead
   9. Miscellaneous

The above chart of marketing expense accounts which provides basic accounting classifications is described in detail as follows:

1. Tank Car Rentals:— To this account should be charged tank car rentals applicable to the accounting period. The tank car rentals may be the amount paid to tank line companies, or it may be the amount charged to market-

*Read before the accounting group of the American Petroleum Institute, Tulsa, Oklahoma, Dec. 9, 1926.

ing expense by the tank car department of the accounting company.

2. Office Salaries:— To this account should be charged the salaries of all employees of the marketing department.

3. Office Expense:— To this account should be charged all expenses incurred in the operation of the office or offices of the marketing department.

4. Advertising:— To this account should be charged the cost of advertising applicable to the accounting period.

5. Discount Allowed:—To this account should be charged the cash discount allowed to customers.

6. Outages and Allowances:—To this account should be charged all outage claims and allowances credited to customers accounts.

7. Traveling Expenses:—To this account should be charged all traveling expense of the employees of the marketing department.

8. General Office Overhead:—To this account should be charged the proportion of the general office and administrative expense applicable to the marketing department for the accounting period.

9. Miscellaneous:—To this account should be charged all miscellaneous expenses of the marketing department not provided for in this chart. Other account classifications under marketing expense should be carried when necessary to meet the requirements of the accounting company.

Gasoline Plant Operating Account

A general ledger account should be carried to which the total manufacturing cost of natural gasoline produced in all plants should be charged. A subsidiary ledger should be maintained with accounts for each plant showing, in classified form, the various items of cost and expense that make up the total manufacturing cost of gasoline. The subsidiary ledger may contain an individual account for each item of cost and expense for each plant, or it may contain one columnar sheet for each plant with a column for total cost, and columns for each classification of cost.

The balance of this account, representing the total cost of gasoline manufactured during the accounting period, will be closed into the profit and loss account at the end of the accounting period.

The manufacturing cost of gasoline manufactured in each plant may be recorded in the following sub-accounts:

III. Gasoline Plant Operating Account:

1. Gas Purchases
2. Absorption Medium
3. Operating Labor
4. Special Labor
5. Repairs
6. Supplies
7. Fuel
8. Water
9. Lubricating Oil
10. Treating
11. Electric Power
12. Taxes
13. Insurance
14. Automobile Expense
15. Office and Laboratory Expense
16. Depreciation
17. General Office Overhead
18. Miscellaneous
19. Residue Gas Sales (Credit)

The foregoing chart of manufacturing cost accounts provides basic accounting classifications to be used, which are described in detail as follows:

1. Gas Purchases:—To this account should be charged the total cost of casinghead gas purchased. Casinghead gas is the basic material used in manufacturing natural gasoline. The total cost of casinghead gas purchased is the material manufacturing cost for the period. The gas is used as received and therefore no consideration is given to inventory, or gas in transit.

2. Absorption Medium:—In an absorption gasoline plant, the absorption medium may be mineral seal oil, charcoal, or some other commodity that when purchased is charged to a warehouse or stores account. The cost of absorption medium used during the month may be obtained from a summary of requisitions of material issued from the stores, or from the monthly inventory report to which the stores account should be adjusted. At the completion of the plant, it is necessary to fill the absorption system with an absorption medium before the plant can be operated. This cost should be charged to plant and equipment under classification (10) other equipment.

3. Operating Labor:—To this account should be charged the salaries of plant superintendent, engineers, stillmen, firemen, oilers, repair mechanics, roustabouts, loading rack men, line walkers, chemists, chief clerk, office employees, and the salaries of all other regular employees.

4. Special Labor:—To this account should be charged the salaries of men employed to make unusual repairs, replacements, etc., and the salaries of all men not regularly employed for plant operation.

5. Repairs:—To this account should be charged the invoice cost, plus delivery cost, of all repairs parts for any part of the plant and equipment, and total cost of all machine shop repair jobs. If repair parts are carried in the warehouse or stores account, the cost of repairs for the month should be obtained from a summary of requisitions of material issued, or from a monthly inventory report to which the stores account should be adjudged.

6. Supplies:—To this account should be charged the cost of all material consumed in the operation of the plant such as greases, waste, batteries, packing, brooms, brushes, etc. If such items are carried in the stores account, the cost of supplies used during each month, should be obtained from a summary of requisitions of material issued, or from a monthly inventory report to which the stores account should be adjusted.

7. Fuel:—Gasoline plants are usually operated by using residue gas as fuel for the whole system. It is used in the operation of engines, boilers, stills, heating plants, ets., and it may or may not be measured. Up-to-date plants have meters measuring the volume of residue gas used in the operation of the plant. In a great many plants however this measurement is not made. If the volume of gas used is determined, it should be charged to the fuel account at the prevailing market price for such gas, with a corresponding credit to the residue gas earnings account.

This account should be charged with the cost of all fuel oil purchased for use in plant operation, as well as the cost of dry gas purchased to meet the requirements of casinghead gas contracts.

8. Water:—This account should be charged with the cost of all water purchased for plant operation.

9. Lubricating Oil:—This account should be charged with the total cost of lubricating oil used at each plant. Lubricating oil is usually purchased in large quantities, the cost thereof being charged to the warehouse or stores account. The cost of lubricating oil used during the month may be obtained from a summary of requisitions issued, or from monthly inventory report showing the amount on hand to which the stores account should be adjusted.

10. Treating:—To this account should be charged the cost of chemicals and other treating materials used in treating gasoline. The usual chemicals charged to this account are caustic soda, chlorine, bleaching powder, litharge and sulphur. The cost of chemicals used during the month may be obtained from a summary of requisitions issued, or from a monthly inventory report showing the amount on hand to which the stores account should be adjusted.

11. Electric Power:—To this account should be charged the cost of electric power purchased for all purposes. Most plants have their own power generation system for plant operation. In the case of emergencies, such as when the plant system is shut down for repairs or otherwise, power is purchased from public companies.

12. Taxes:—To this account should be charged the proportion of ad valorem, special improvement, franchise and all other taxes applicable to each plant for the month. A monthly accrual should be made for taxes, by a charge to this account, with a corresponding credit to accrued taxes payable.

13. Insurance:—To this account should be charged the proportion of insurance applicable to each plant for the month. A monthly accrual should be made for insurance by a charge to this account, with a corresponding credit to prepaid insurance, or accrued insurance payable.

14. Automobile Expense:—To this account should be charged each plant's proportion of the automobile operating and maintenance expense for the month.

15. Office and Laboratory Expense:

—To this account should be charged the cost of such items as stationery, meter charts, postage, office supplies, office machine repairs, ice, replacement of laboratory equipment, chemicals, and all other items of expense directly applicable to plant offices or laboratories.

16. Depreciation:—To this account should be charged the amount of depreciation of plant and equipment sustained during the accounting period. The depreciation may be computed by using a composite straight line depreciation rate, different straight-line depreciation rates for each classification of plant and equipment, or the production unit-cost method. The production unit-cost depreciation method is explained hereinafter.

17. General Office Overhead:—To this account should be charged the proportion of the general office expense applicable to the operation of each plant. General office expense includes not only the expense of maintaining a general administrative office, but usually such items as salaries of general superintendents, gas testers, metermen, etc., whose time may be used for the benefit of all plants in a certain district, or all plants owned by the accounting company.

18. Miscellaneous:—To this account should be charged all manufacturing cost and expense that is not chargeable to other accounts.

19. Residue Gas Sales (Credit):—To this account should be credited the sales value of residue gas sold. If the volume of residue gas used as fuel in plant operation is measured, this account should be credited with the value thereof, by charging a corresponding amount to operating account (7) fuel.

The balance of this account is deducted from the balance of the gas purchases account to ascertain the net cost of gas manufactured into gasoline.

Plant and Equipment

A general ledger account should be carried in which the total cost of gasoline plants and equipment is recorded. This account may be called the Plant and Equipment Account. It should be the controlling account of the subsidiary records in which the plant and equipment cost is recorded for each plant according to appropriate sub-classifications of construction and acquisition cost. The subsidiary plant ledger may contain an account for each sub-classification of cost under each plant or, it may contain one columnar sheet for each plant with the sub-classification distributed thereon.

Plant construction and acquisition cost may be classified according to plant subdivisions and process units, such as absorption equipment, stills, heat exchangers, condensers, field gathering lines, etc. To make such a classification of plant and equipment, it would be necessary to maintain complete cost accounts for material, labor and overhead during the period of construction. The natural gasoline manufacturing process is one of continuous production and it is unnecessary to compute the production cost by process units. The manufacturing cost is recorded for the whole plant, and the unit production cost per gallon is then determined by dividing the total plant production cost by the number of gallons of gasoline produced. The manufacturing cost per gallon of gasoline is the only unit cost necessary.

For the reasons stated in the preceding paragraph, it is considered better practice, by those in the industry, to record plant and equipment cost in sub-classifications according to the kind of material used in the construction of the plant. The most important reason for making a classified analysis of plant and equipment cost in the accounts, is to afford an accurate base for the computation of depreciation.

The plant and equipment cost should be classified first into two subdivisions (1) tangible plant and equipment, that will have a residual or salvage value at the end of the operating life of the plant, and (2) intangible construction cost such as labor, hauling, etc., and all other construction cost, such as masonry and other material that will not have residual or salvage value at the end of the operating life of the plant. The plant and equipment sub-accounts should be grouped according to the two sub-divisions for the purpose of ascertaining the total of each, and depreciation should be computed on the depreciation base determined by deducting an estimated per cent of salvage value from the tangible plant and equipment cost only.

The following sub-classifications of the plant and equipment account may be used, when modified to meet the particular requirements of the accounting company:

IV. Plant and Equipment (Tangible equipment having a residual value):
1. Engines and compressors.
2. Pipe.
3. Tanks.
4. Boilers.
5. Pumps.
6. Fittings.
7. Electrical equipment.
8. Recording and indicating instruments.
9. Office and laboratory equipment.
10. Other equipment.
11. Buildings.
(Intangible cost having no residual value.)
12. Masonry construction.
13. Labor.
14. Freight and hauling.
15. Miscellaneous.
16. Casinghead gas contracts.

The sub-classifications of the plant and equipment occount should be definitely defined to meet the operating requirements of the accounting company. The accounts listed in the above chart may be described as follows:

1. Engines and Compressors:—To this account should be charged the cost of all engines and compressors, direct driven or belted, for gas, or vapor compression, and engines for auxiliary power, starting air compressors, vacuum pumps and gas blowers.

2. Pipe:—To this account should be charged the cost of all metal pipe, except nipples up to and including twelve inches in length, which should be charged to account (6) fittings. Large pipe when manufactured into tanks should be charged to account (3) tanks.

3. Tanks:—To this account should be charged the cost of all tanks, regardless of usage, including tanks purchased for absorbers, stills, scrubbers, dephlegmators, and all special tanks used as towers, as well as steam boilers purchased for gasoline or oil stills. The steel stacks on such boilers should be charged to account (10) other equipment.

4. Boilers:—To this account should be charged the cost of all boilers used for generating steam, including steel stacks used on steam boilers.

5. Pumps:—To this account should be charged the cost of all pumps used for motivating fluid other than gases, including water well pumping heads, frames and working barrels complete with rods.

6. Fittings:—To this account should be charged the cost of all pipe connections usually classed as fittings, all pipe nipples not over twelve inches in length, valves of all descriptions, regulators, traps, headers (cast metal or pipe welded), steam separators and all other fitting specialties manufactured to be connected directly into pipelines.

7. Electrical Equipment:—To this account should be charged the cost of motors, generators, transformers, switchboards complete with all electrical instruments, connections, starting rheostat, watt meters, electrical wiring, poles and all special electrical materials, fittings and connections.

8. Recording and Indicating Instruments:—To this account should be charged the cost of all instruments for indicating, or recording time, pressure, temperature, the flow of gas or liquid, and gauge boards for mounting such instruments.

9. Office and Laboratory Equipment:—To this account should be charged the cost of all office furniture, filing cabinets, typewriters, adding and calculating machines, special test instruments, hydrometers, thermometers, glassware and other miscellaneous office and laboratory equipment.

10. Other Equipment:—To this account should be charged the cost of all equipment, having a tangible or residual value, purchased and used in gasoline plant construction, other than that charged to specific equipment classifications.

11. Buildings: — To this account should be charged the material cost of all structures for housing equipment, processes, shelters and dwellings ex-

cept foundations, paint and electrical wiring.

12. Masonry Construction:—To this account should be charged the cost of all material for foundations, footing, sumps, sidewalks, boiler settings, fire still settings, exhaust stacks and conduits, as well as all sand, cement, gravel or aggregates wherever used.

13. Labor:—To this account should be charged the cost of all labor and supervision employed in the construction of the plant and auxiliary units.

14. Freight and Hauling:—To this account should be charged the cost of all hauling and freight on material used in the construction of the plant.

15. Miscellaneous:—To this account should be charged the cost of all construction material having no residual value. To this account should also be charged the cost of rights-of-way, surface leases, damages and insurance during course of construction and other intangible costs not provided for otherwise.

16. Casinghead Gas Contracts:—To this account should be charged the cost and expense incurred in the acquisition of casinghead gas contracts. In case a plant is purchased, this account should be charged with the excess of the purchase price over the inventory or appraisel value of the plant.

Depreciation

Depreciation of plant and equipment is one of the elements of manufacturing cost recorded in a sub-division of the gasoline plant operating account. It is important that the monthly plant statements contain an accurate estimate of the amount of depreciation sustained for the month. An operating statement without depreciation may be useful from a managerial viewpoint, but it will not show the cost of the product nor can operating results be ascertained therefrom.

Depreciation may be computed by using any method that will provide during the operating life of the plant, a reserve for depreciation equal to the total cost of the plant and equipment, less the residual or salvage value of the plant at the time of dismantling.

If an estimate of the future gasoline production of the plant is made, it is possible to compute depreciation by using the production unit cost method. This method will amortize the plant and equipment cost and provide the cost per gallon for the monthly depreciation entry. The production unit cost method will now be explained.

Estimate of Plant Production

The gasoline production of the plant, both past and estimated future, is herein referred to as the ultimate gasoline production. Careful consideration should be given to the manner in which the future gasoline production is determined. The method which will be outlined has proven to be reasonably accurate, and not only may be used for accounting purpose but is of value from an operating viewpoint.

The gasoline plant operator either owns the oil property from which casinghead gas is taken or has the casinghead gas rights by reason of a contract with the oil producer, either for the producing life of the property, or for a period of years. The various producing properties may differ in characteristics which have a bearing upon the future gasoline production, such as thickness of sand, richness of casinghead gas, position on the struc-

(Continued on page 84)

Statement 1

PETROLEUM PRODUCTION CORPORATION
STATEMENT OF PROFIT AND LOSS FOR YEAR 1926
Plant No. 9

	Gallons	Price	Amount	Amount
Sales	6,845,312	.10		$684,531.20
Cost of Gasoline Sold:				
Inventory, January 1, 1926	365,429	.0841	$ 30,732.58	
Gasoline and Naphtha Purchased	1,884	.09	169.56	
Cost of Gasoline manufactured (See Statement No. 2)	6,619,233	.0851	563,296.73	
	6,986,546		$594,198.87	
Less: Inventory Dec. 31, 1926	141,234	.0851	12,019.01	
Cost of Gasoline Sold	6,845,312			$582,179.86
Gross Profit on Gasoline Sold				$102,351.34
Marketing Expense:				
Tank Car Rentals			$ 25,507.66	
Office Salaries			5,010.20	
Office Expense			2,289.80	
Advertising			1,000.00	
Discount Allowed			5,761.26	
Outages and Allowances			3,833.26	
Traveling Expense			503.20	
General Office Overhead			330.80	
Miscellaneous			416.00	
Total Marketing Expense				46,652.18
Net Profit from Operations				$ 55,699.16
Other Income				1,843.61
Net Profit for Year 1926				$ 57,542.77

Statement No. 2

PETROLEUM PRODUCTION CORPORATION
STATEMENT OF MANUFACTURING COST FOR YEAR 1926
Cost of Gasoline Manufactured

	M. Cu. Ft.	Amount	Cost Per Gallon
Gas Purchased	4,563,541	$228,177.05	$ .03447
Less: Residue Gas Sold		76,058.68	.01149
Gas Used		$152,118.37	$ .02298
Absorption Medium		4,841.80	.00073
Operating Labor		48,250.80	.00729
Special Labor		24,820.60	.00375
Repairs		40,124.00	.00606
Supplies		32,875.46	.00497
Fuel		12,804.56	.00193
Water		14,670.10	.00221
Lubricating Oil		1,314.01	.00020
Treating		10,674.00	.00160
Electric Power		10,118.87	.00153
Taxes		6,120.00	.00093
Insurance		3,086.71	.00047
Automobile Expense		10,056.81	.00152
Office and Laboratory Expense		26,012.14	.00393
Depreciation		132,384.66	.02000
General Office Overhead		2,456.72	.00037
Miscellaneous		30,617.12	.00463
	Gallons		
Total	6,619,233	$563,296.73	$ .08510

Statement No. 3

PETROLEUM PRODUCTION CORPORATION
SUMMARY STATEMENT OF SALES, GROSS AND NET PROFIT
FOR YEAR 1926

Plant	Sales	Cost of Gasoline Sold	Gross Profit	Marketing Expense	Net Profit	Gallons Sold	Net Profit Per Gallon
1	$351,123.45	$ 239,969.10	$ 120,154.35	$ 23,557.91	$ 96,596.44	3,418,697	$ .02825
2	41,984.73	51,440.31	9,455.58	1,134.21	10,589.79	401,239	.02639
3	1,102,456.31	712,124.62	390,331.69	80,946.21	309,385.48	12,391,264	.02497
4	513,782.39	360,012.17	153,770.22	50,126.91	103,643.31	6,195,132	.01673
5	204,866.99	200,833.38	4,033.61	16,319.21	12,285.60	2,260,634	.00543
6	36,661.78	31,102.31	5,559.47	2,001.32	3,558.15	420,958	.00845
7	210,319.62	140,693.17	69,626.45	17,612.39	52,014.06	2,912,369	.01786
8	100,093.21	81,332.42	18,700.79	10,598.24	8,102.55	1,012.369	.00800
9	684,531.20	582,179.86	102,351.34	46,652.18	55,699.16	6,845,312	.00814
10	178,392.41	79,451.23	96,931.18	10,681.24	88,249.94	2,112,369	.04177
Total	$3,424,212.09	$2,470,208.57	$ 954,003.52	$ 259,629.82	$ 694,373.70	37,970,343	....

AVERAGE SELLING PRICE, COST, AND NET PROFIT
PER GALLON OF GASOLINE SOLD

Plant	Sales	Cost of Gasoline Sold	Gross Profit	Marketing Expense	Net Profit	Gallons Sold	Total Net Profit
1	$ .10271	$ .06756	$ .03515	$ .00690	$ .02825	3.418,697	$ 96,596.44
2	.10464	.12820	.02356	.00283	.02639	401,239	10,589.79
3	.08897	.05747	.03150	.00653	.02497	12,391,264	309,385.48
4	.08293	.05811	.02482	.00309	.01673	6,195,132	103,643.31
5	.09062	.08884	.00178	.00721	.00543	2,260,634	12,285.60
6	.08709	.07388	.0'321	.00476	.00845	420,958	3,558.15
7	.07222	.04831	.02391	.00605	.01786	2,912,369	52,014.06
8	.09887	.08040	.01847	.01047	.00800	1,012,369	8,102.55
9	.10000	.08505	.01495	.00681	.00814	6,845,312	55,699.16
10	.08445	.03762	.04683	.00506	.04177	2,112,369	88,249.94
Average	$ .09018	$ .06506	$ .02512	$ .00684	$ .01829		

Problems Found and Overcome in Refining Panhandle Crude

Experience in Marland plants has not fully determined value to refiner as compared with other Mid-Continent oils

By WALTER MILLER*
Marland Refining Company

THE daily production of crude from the Panhandle field amounts to approximately 175,000 barrels at the present time. That the area is one of major importance and will be a powerful factor in the oil industry is an already demonstrated fact. Predictions are freely made that the field will exceed 300,000 barrel per day in the not far distant future, as the limiting factors—transportation problems — are gradually solved. However, the solution of the Panhandle crude refining problem is of much broader importance than its mere application to the crude oil from this particular field. Geologists tell us that not only the entire Texas Panhandle but practically the entire western part of the state south of the Panhandle area as far as Pecos and Crockett County, and including the southeastern corner of New Mexico, in which the Artesia pool development is taking place, was once a great inland salt sea. During the period leading to its ultimate evaporation there were deposited the limestone and dolomite formations, from which the production of that section of Texas is largely obtained.

The Westbrook, Big Lake, Upton-Crane and Panhandle areas, are all within and constitute but a small part of the roughly estimated 55,000,000 acres making up this great area.

Source of Sulphur

Oil produced under such geological conditions, which include the final deposits of rock salt over the lime and dolomite formations, has usually been found to contain higher percentages of sulphur compounds than in petroleum from most other types of geological structures.

What the production from this vast territory will ultimately amount to no man can say, but it is quite certain that refiners in this country will, within the next few years, be handling a much larger proportion of their total runs in the form of crude oil produced from this remarkably prolific area. The developed pools will produce large quantities for many years and new highs will be continually discovered which will augment the present pools. Most, if not all, of that crude will have many characteristics in common with those we are finding in Panhandle. While none of the other pools within this area have the high wax content of Panhandle, they are nevertheless similar in having at least a fair proportion of paraffine wax, in containing comparatively high amounts of sulphur and in carrying quantities of free hydrogen sulphide in solution. The actual processing of millions of barrels has demonstrated that Big Lake crude is much less desirable to refiners than average Mid-Continent crude, both because of corrosion problems and greater difficulty in refining. In fact, the principle difference between Panhandle and the other crudes from this geological areta is in the much higher wax content of Panhandle and the apparently greater tendency of the latter crude to hold salt water in suspension, which is probably due to this high wax content.

*Before American Petroleum Institute, Tulsa, Oklahoma, December 8, 1926.

Average Sample

A sample tested in the Marland laboratory, which represented a fair average of the crude received at our refinery, showed the following characteristics, which we believe are typical of the field as a whole:

1. Average gravity—37.5.
2. Color—Dark Green.
3. Water by distillation—1 per cent approximately.
4. Congealing point—50 to 60 degrees F.
5. Viscosity—61 at 100 Saybolt Universal.
6. Asphalts (By absorption through Fullers Earth) 17 to 19 per cent, approximately.
7. Wax (Ether-Alcohol Method) 16 to 17 per cent, approximately.
8. Sulphur Content (Parr Oxygen Bomb)—0.65 per cent.
9. Salt Content—16 gms. per barrel.
10. Carbon Residue—2.88 per cent (Conradsen).
11. Coke by distillation—3.00 per cent.

In connection with the foregoing, we conducted some months ago a very interesting experiment to determine the changes made in the gravity, gasoline content and cold test by subjecting the crude to cracking temperatures and pressures. Straight crude (A) was pumped through a small coil of one-inch high pressure pipe at the rate of about one eighth of a gallon per minute, at which rate the crude took about fifteen minutes to go through the coil. Two experiments were run, each at 250 pounds pressure, one (B) at a temperature of about 750 degrees, the other (C) at a temperature of about 850 degrees.

Influence of cracking on certain characteristics of Panhandle Crude

	Normal Crude (A)	Cracked Crude 750°T (B)	Cracked Crude 850°T (C)
Pressure Used	..	250 lbs.	250 lbs.
Temperature used	..	750°F.	850°F.
Gravity, A. P. I.	35.7	39.7	40.3
Caybold Viscosity at 100°	54	39	35
Wax Content (by Ether-Alcohol Method)	19.16%	15.13%	9.34%
Gasoline Content	29.8 %	34.0 %	38.4 %
Cold Test	64°F.	12°	0°†

†Flowing.

A remarkable feature in the changes caused by cracking as above is the fact that the reduction in wax content was almost exactly equivalent to the increase in gasoline.

The water content is, of course, a variable, depending partly upon the particular well or wells from which the crude is obtained, and largely upon the degree of settling to which the crude has been subjected. Excessive water will settle out fairly quickly in tanks, down to one-quarter of one per cent, when the crude is at average summer temperature. The sulphur content of this particular sample is about the average of the crude being received by us, although some parts of the field seem to run slightly higher, in some cases as high as 1 per cent to 1.1 per cent. The concentration of salt in the crude does not seem to be entirely dependent upon the amount of water shown by distillation. We have had instances of several crude oils yielding by distillation .2 of 1 per cent of water, but apparently varying in salt content from 5 to 40 grams per barrel. Whether this indicates a suspension of saturated salt solution difficult to remove because of the presence of wax, or whether there is an actual suspension of salt crystals in the crude, is something we have not as yet determined.

Gravity Uniform

We will not attempt to go into exact differences in yields. The gravity of Pan-

PROPERTIES OF PANHANDLE CRUDE

1—Gravity	37.5
2—Color	Dark Green.
3—Water by distillation	1% approximately
4—Congealing point	50 to 60°F
5—Viscosity	61 @ 100 Saybolt Universal.
6—Asphalts by absorption thru Fullers Earth approx.	17 to 19%
7—Wax approximate by Ether-Alcohol Method	16 to 17%
8—Sulpher content (Parr Oxygen Bomb)	.65%
9—Salt content	16 Grams per Bbl.
10—Carbon residue (Conradson)	2.00%
11—Coke by distillation	3.00%

handle crude runs quite uniform, the bulk of it weighing between 36 and 38 degrees A. P. I. The U. S. Motor Gasoline yield varies roughly from 28 to 32 per cent, 30 per cent being a fair average. The 41-43 degrees A. P. I. kerosene fraction will range from 6 to 8 per cent, these results differing slightly in different refineries. A laboratory distillation of a 37.5 degrees crude sample in a comparatively efficient apparatus, with steam introduced after the gasoline fraction had been taken off, to prevent cracking, gave the following results, which we believe to be a good average of the field, varying with lighter or heavier crude:

Gasoline—30.7%

Gravity	58.4
I. B. P.	136.
E. P.	435

Kerosene—7.7%

Gravity	41.3
Flash	186
Fire	206

Gas Oil—22.4%

Gravity	35.0
Flash	200
Fire	225

Wax Dist.—13.9%

Gravity	30.0
Flash	220
Fire	300
Viscosity at 100	106
C. T.	91

Bottoms—34.5%

Gravity	21.0
Flash	530
Fire	610
Viscosity at 210	290
C. T.	59
Color	Black

Loss—.8%

Engler Distillation on Gasoline from Small Tower

Gravity	58.4
I. B. P.	136
10%	188
20%	208
30%	228
40%	246
50%	268
60%	290
70%	316
75%	330
80%	344
85%	360
90%	384
95%	419
E. P.	435

The foregoing laboratory yields are based upon running to a comparatively heavy fuel oil bottom but taking wax distillate overhead.

Yields

Marland Refinery operating conditions are such that we have made no attempt to utilize any fraction of the Panhandle crude we process for lubricating oil or wax recovery. About half of the 28,000 to 30,000 barrels charged daily to the crude stills consists of Oklahoma crudes and supplies the basic material for our paraffine wax, neutral oil and filtered cylinder stock operations, the overhead gas oil being used as cracking stock for Fleming Process cracking stills. The other half of the crude—our charge of Panhandle—is put through two large pipe stills, one equipped with a set of one flashing and two medium height bubble towers, the other with one single large bubble tower about 11 feet in diameter and 78 feet in height. Both of these stills are equipped with what to the uninitiated is a bewildering array of tubular heaters and exchangers. In these units the Panhandle crude is stripped of its gasoline, kerosene and light gas oil fractions, the gas oil being used as a charging stock for the Cross stills, while the residue is charged to Dubbs cracking stills. The yields are approximately as follows:

Gasoline—30.4%

Gravity	59°A.P.I.
I. B. P.	114°F.
90%	390°F.
E. P.	435°F.
Color	30
Sulphur	.1%

Kerosene—7%

Gravity	41.5A.P.I.
Flash	170°F.
I. B. P.	380°F.
Color	15
Sulphur	.23%

Gas Oil—11.1%

Gravity	37.5A.P.I.
Flash	250°F.
I. B. P.	480°F.
Sulphur	.4%

Residuum—50%

Gravity	27.0A.P.I.
Flash	320°F.
I. B. P.	536°F.
Vis. Furol	29 at 122
Vis. Sayboldt	68 at 210
Sulphur	.68%
Loss	1.5 %

While we show yields in U. S. Motor Gasoline, the usual variations in cuts to higher or lower end points to suit market requirements are available to the refiner. Also the percentage of light gas oil taken off can be varied as requirements dictate the making of a greater or lesser quantity of charging material for the various types of cracking units.

With the exception of the difficulties brought in by the corrosion problems and salt content of the crude, our operation to this point is quite orthodox. The extra wax content and high congealing points are not particularly troublesome in the refinery, whatever difficulty they may cause in field handling and transportation.

Running to Coke

Some of the eastern refiners are running Panhandle to coke instead of to a

INFLUENCE OF CRACKING ON CERTAIN CHARACTERISTICS OF PANHANDLE CRUDE

	Normal Crude A	Cracked B	Crude C
Pressure used	—	250 Lbs.	250 Lbs.
Temperature used	—	750 °F.	850 °F.
Gravity A.P.I.	35.7	39.7	40.3°
Saybolt Viscosity @ 100°	54	39.	35.
Wax Content by Ether-Alcohol Method	19.16%	15.13%	9.34
Gasoline Content	29.8	34.0	38.4
Cold Test	64 °F.	12 °F.	0. Above

LABORATORY DISTILLATION OF PANHANDLE CRUDE

GASOLINE AND KEROSENE OVER SMALL TOWER

GASOLINE	30.7 %
GRAVITY	58.4
INITIAL BOILING POINT	136.
END POINT	435.
KEROSENE	7.7 %
GRAVITY	41.3
FLASH	186.
FIRE	206.
GAS OIL	22.4 %
GRAVITY	35.0
FLASH	208.
FIRE	225.
WAX DISTILLATE	13.9 %
GRAVITY	30.6
FLASH	320.
FIRE	350.
VISCOSITY @ 100°F	106.
COLD TEST	91.
BOTTOMS	24.5 %
GRAVITY	21.0
FLASH	530.
FIRE	600.
VISCOSITY @ 210°F	290.
COLD TEST	59.
COLOR	BLACK.
LOSS	0.8 %

ENGLER DISTILLATION ON GASOLINE FROM SMALL TOWER

GRAVITY	58.4
INITIAL BOILING POINT	136.
10 %	188.
20 %	208.
30 %	228.
40 %	246.
50 %	262.
60 %	290.
70 %	316.
75 %	330.
80 %	344.
85 %	360.
90 %	384.
95 %	419.
END POINT	435.

liquid residue end product in the primary distillation. The Prudential Refinery at Baltimore, for illustration, are processing considerable quantities in the following manner: From 32 to 36 per cent of the crude oil is first taken off overhead in the form of crude naphtha. The bottoms are then recharged directly to typical side-fired cylindrical coking stills equipped with conventional fractionating towers. The products cut from this operation consist of a small amount of cracked crude naphtha distillate, a re-run distillate which contains the kerosene fraction, a light and heavy gas oil, a paraffin distillate, a heavy overhead fuel oil and the usual wax tailings or wax slop cut made during the process of coking the still. The re-run distillate obtained overhead from the coking still is re-run for kerosene, a small amount of cracked naphtha made while running to coke taken off overhead, and the bottoms are thrown into gas oil. In this particular refinery all of the naptha cuts are thrown together, given the necessary acid treatment and redistilled in steam stills for the desired gasoline cuts. The coke produced in the coking operation of the topped crude runs from 11 to 12 pounds per barrel charged to the coking still. The gas oil cuts and the overhead fuel oil, the latter ranging from 28 to 30 degrees gravity, are used as charging stock for cracking stills.

Corrosion Problems

The corroding substances encountered in refining Panhandle crude are hydrogen sulphide (H_2S) and hydrogen chloride (HCL). Hydrogen sulphide is encountered partly as free gas in solution and partly as formed by the breaking up of the sulphur compounds due to the heat of distillation. Hydrogen chloride is probably formed by the breaking down of magnesium chloride present in small percentages in the salt solution, the reaction being brought about in the presence of water particles by the influence of the heat of distillation. This hydrogen chloride on reaching the condensing point and combining with any water present forms a weak hydrochloric acid, very destructive in its action.

Our experience indicates that little if any of the magnesium salt which may enter the tube stills with the sodium chloride survives the primary distillation, and the corrosion problems of the subsequent cracking and re-running operations are limited to those of the sulphur compounds.

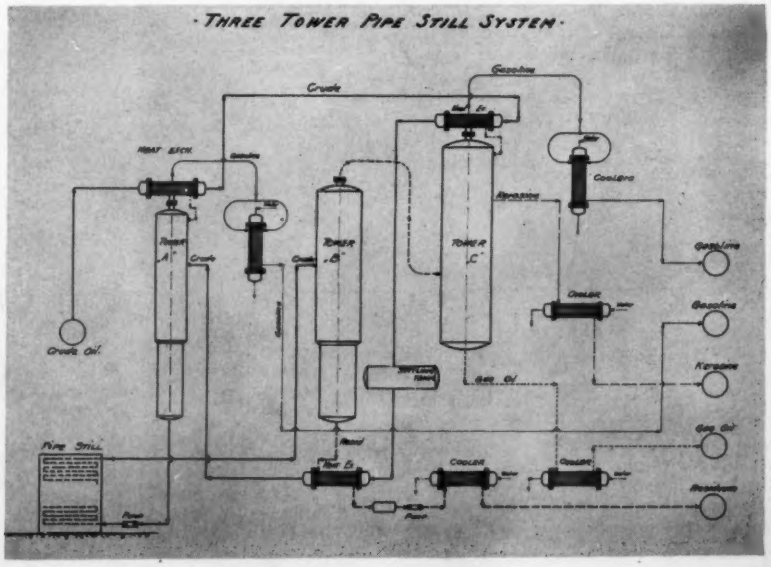
One of the steps in combating corrosion in our primary distillation units is the elimination of salt so far as practicable, so as to reduce as much as feasible the possible production of hydrogen chloride, as well as to eliminate the deposition of normal salt in the apparatus. What we are doing and attempting to do in salt elimination is touched upon in another paragraph. In both our three-tower and one-tower distillation units we introduce ammonia into the system at the rate of about ten pounds per thousand barrels of crude charged, about half being put into the crude stream. The quantities are measured by setting the ammonia drum on a platform scale, connecting it to the inlet line of the crude oil pump and controlling the rate of flow through a needle valve. The balance of the ammonia is introduce into the base of the final tower. We have ample evidence, in the form of tests of the gases evolved and in deposition of ammonium chloride in various parts of the system, that this amount of ammonia is sufficient to counteract the effect of such hydrogen chloride as may form from the magnesium salt in crude carrying as much as 50 grams of total salt per barrel.

Counteracting Methods

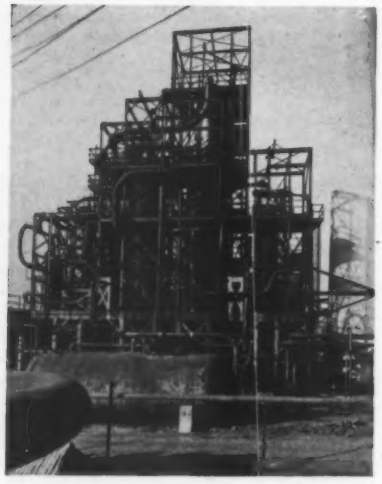
It would be a very expensive proceeding to neutralize with proper chemicals all the hydrogen sulphide liberated during the primary distillation. Fortunately in the vapor phase hydrogen sulphide gas is not a very active corroding agent at low temperatures. Its activity becomes dangerous at temperatures ranging upward from 500 degrees F. Therefore, the two danger points in hydrogen sulphide corrosion are at the high temperatures and in the condensing system.

There are two practical methods for counterating the corrosive action in the condensing zone. Ammonia is an impractical neutralizer here because of the expense involved, even though complete neutralization seems unnecessary as shown by experience. Incidentally, the use of excess ammonia has a considerable deleterious effect on the admirality metal tubes used in most of the modern tubular exchangers and condensers.

The first of the two methods for the



THREE TOWER PIPE STILL SYSTEM



condensing system is that of adding to the condensing vapors a weak solution of soda ash. Our practice calls for about 25 barrels an hour of a 1 to 3 per cent solution. This must be introduced at a point where the temperature of the vapor stream is not high enough to vaporize the water. The effect is to neutralize in part the hydrogen sulphide and at the same time provide a diluting agent which so reduces the concentration as to slow up the corrosive action to tolerable limits. The second method is simply to introduce a large quantity of water into the vapor stream at some suitable point in its path, (and by a large quantity of water is meant from one and one-half to two gallons of water for each gallon of condensed distillate). In this way the hydrogen sulphide is literally drowned by diluting it to nearly zero concentration, thus slowing up the corrosive action to a low limit without the expense of a chemical.

It must not be inferred that after we had done the above things we had no corrosion. On the contrary, we still have very perceptible and expensive corrosion taking place. If, however, we did not provide against it, our equipment would last but a short time indeed. It is quite possible that we have greater difficulties in our primary distillation units than would have been our lot had these plants been designed originally for Panhandle crude operation.

Corrosion in Cracking

On our Cross cracking stills, in which we crack the Panhandle light gas oil, we have used no chemicals, as we expected little excessive corrosion. The sulphur content of the light gas oil fraction does not run above .4 of 1 per cent, and the only difficulty observed at the start was in the reboiler tubes. We thought this might have been an effect more of erosion. However, we are planning the use of a small amount of chemical because of an action, comparatively slow but none the less definite and positive in the tubes. We have observed no action in the balance of the apparatus.

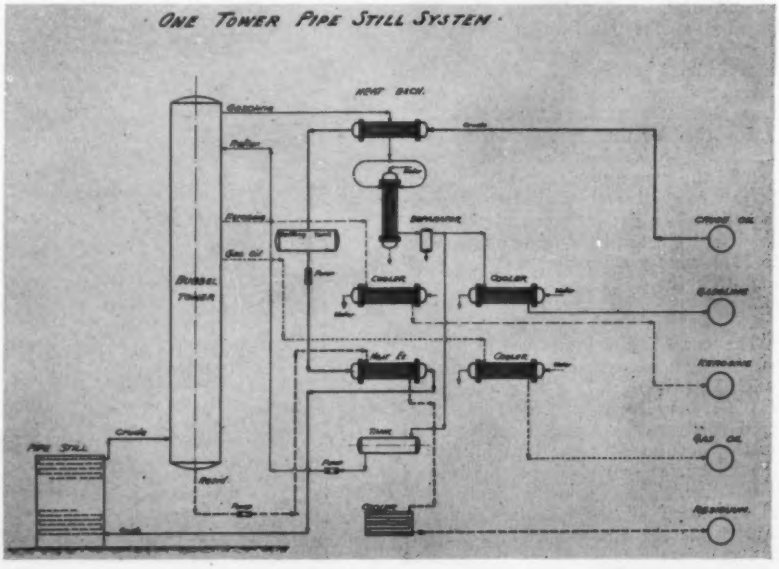
On our Dubbs units the problem is again a real one. The residue charged to the plant has usually a little more sulphur than the original crude, and preventive measures are essential. Our practice is to introduce a mixture of caustic and ammonia into the charging line of each unit. This consists of a mixture of 13 Beaume caustic and 26 Beaume aqua ammonia in the proportion of one gallon of aqua ammonia to one hundred gallons of 13 Beaume caustic solution, and is pumped into the system by special Hills-McKenna pumps at the rate of 16 gallons per hour per unit. This is at the rate of .178 pounds of caustic per barrel of charging stock. The tube plug shows a fairly high rate of corrosion. Some corrosion is noted on the dephlegmator wall opposite the inlet pipe. There is also corrosion in the usual corrosion area in the reaction chambers, this area being all of the head and the side walls down for about three feet. Neither of these last two items are serious, and we have not as yet lined these places, although we are prepared to do so in the near future. We have more corrosion in our tubes than we anticipated, although Dubbs field inspectors tell us that judging by the amount of throughput rather than hours of running we get a normal service.

As an industry, we have not approached the limits of possible prevention and control of corrosion by chemical means, and it might be said we have hardly started taking advantage of recent metallurgic progress in this direction.

Salt Problems

As stated before, salt water in the crude will settle out quite rapidly at normal summer temperatures down to .2 of 1% from the bulk of the oil in the tank, the last four or five feet being of a higher concentration. It is a characteristic of the crude that the ordinary centrifuging test seldom throws out all the water present and the distillation method has to be relied on for accurate determinations. In the attempt to reduce this salt water content we have followed to some extent the experience and practice of the Amarillo Refining Company plant in Amarillo, Texas, probably the first refinery to run this crude exclusively. The crude stream going through the various heat exchangers is diverted, when a temperature of from 200 to 250° has been reached, to a settling tank, which in our case is a horizontal shell 10 feet in diameter by 30 feet in length, with provision for leading any evolved vapors in the tower system of its particular unit, and for drawing off such salt water as settled out from the bottom, the balance of the entering liquid being picked up by another pump.

While we have been able to take out a part of the salt water still remaining in the crude, and thereby reduce the rate of salt deposition on the heating surfaces correspondingly, this method has been only partially satisfactory. It is considered advisable to permit the settling of salt water to take place before the temperature has reached a point where generation of steam may occur under the pressure involved. Also there is a possibility that hydrogen chloride may be liberated from the magnesium salts present at temperatures as low as 220° F. and with increased rapidity with higher temperatures. Incidentally, the flashing off of water would tend to the formation of salt crystals directly suspended in the crude, and therefore difficult to settle out. As stated, this settling method is only partially successful. Whether larger settling units would give materially better results is debateable, although we were unable to notice any material improvement in



conditions when using two drums in parallel for settling purposes, thereby providing twice the settling time.

Washing to Be Tried

We believe that a better method than this will ultimately be found. In one refinery a washing equipment is being installed, consisting of two tanks, in one of which crude is distributed through a perforated spider coil located about three or four feet above the bottom of the tank, the crude flowing upwardly through the water bath to an outlet 20 or 25 feet above the inlet, warm water being introduced also through a perforated spider coil, a few feet below the oil outlet, flowing down through the crude and drawn off the bottom. The second tank is used for final settling. Small size experiments have indicated that at temperatures as low as 135° F. no emulsion is formed under such conditions.

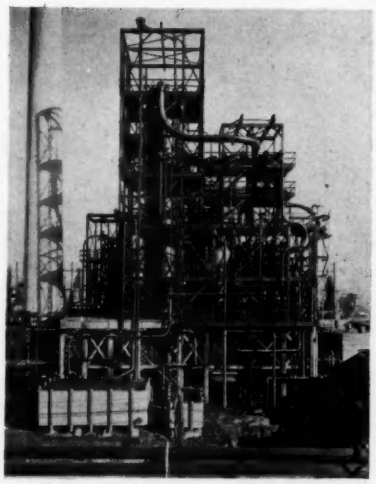
Unfortunately this insallation is not yet ready for operation and there is is a question whether the contact between water and oil will be intimate enough to accomplish the desired aim. We are carrying on experiments on a somewhat larger than laboratory scale along similar lines. If such a scheme can be successfully worked out, many advantages will accrue. Even though all the water may not settle out in practice, the great bulk of the salt content should be eliminated, and the remaining solution be of very low concentration. Such a method should also take out the greater part of the hydrogen sulphide in solution in the crude and reduce that phase of the corrosion problem. If no better scheme can be devised than the settling method now employed by us, our plan is to equip one of our units with a much larger settling capacity and by reduction of the velocity of the heated crude and the further study of the temperature conditions most favorable, to bring about a more complete and satisfactory elimination of salt.

While the salt deposits are easily cleaned out by means of hot water or steam, they nevertheless involve fairly frequent shutdowns of equipment and consequent loss of capacity, as well as hot tube trouble and a decrease of heat conductivity. This difficulty is not confined to a pipe still proper, as salt deposition takes place all along the line in the crude heating exchangers.

The benefical effect of any system which substantially eliminates all the salt is not limited to the primary distillation units, but will be advantageous, at least in our case, in cracking operations. Salt crystals held in suspension in the reduced crude from the primary still, amounting to from 15 to 35 grams per barrel of residuum, become a plague in the tubes of the Dubbs stills, depositing with coke on the interior of the tube walls; lessening heat transmission, causing overheated and burned out tubes, shortening runs as well as the life of the tubes increasing measurably the difficulty of clearing the tank between runs, and generally constituting a curse on the poor refiner. However, we have had little or no indication of any magnesium chlorides carrying through to our Dubbs units in the residual of the crude. Cracking:

Gasoline Yield

The operation of our two 2000-barrel capacity Cross cracking units on the light gas oil fraction from Panhandle crude does not differ materially from the cracking of Mid-Continent gas oils. The stills are run to make end point gasoline, which is treated in the vapor phase Gray process towers. While the sweetening of the gasoline is slightly more difficult, the effect of sweetening on color stability is about the same.



Our Dubbs cracking stills are the ninety tube type equipped with two 10x40-foot reaction chambers, with a charging capacity when operating on Panhandle residuum of about 1800 barrels per operating day, running to coke. These are larger Dubbs units than any in operation now, with the exception of one in the Richmond refinery of the Standard Oil of California. The results of cracking the 26 to 27° A. P. I. gravity residuum from our pipe stills have been very satisfactory, difficulties due to corrosion and salt excepted. We are obtaining average yields of about 77% of 54 to 55° A. P. I. pressure distillate of from 490 to 510 end point, yielding in turn 65% to 70% of gasoline of U. S. Motor distillation range, the pressure distillate bottoms on rerunning ranging from 34 to 36° gravity. This distillate presents no unusual problems in treating and finishing as compared with Dubbs distillate produced from other average Mid-Continent crude residues, with the single exception, as was also evident in the product of the Cross stills, of a slightly increased difficulty in sweetening. While we are finishing and decolorizing it by rerunning in fire stills without steam and passing the vapors through Gray Process Vapor Filtration Towers, from which we are getting very satisfactory results, our Laboratory experiments indicate that those using the more orthodox method, i. e., fairly heavy acid treating followed by neutralizing and sweetening and redistillation in steam stills at low temperatures will be able to get results comparable with their practice on products from other sources.

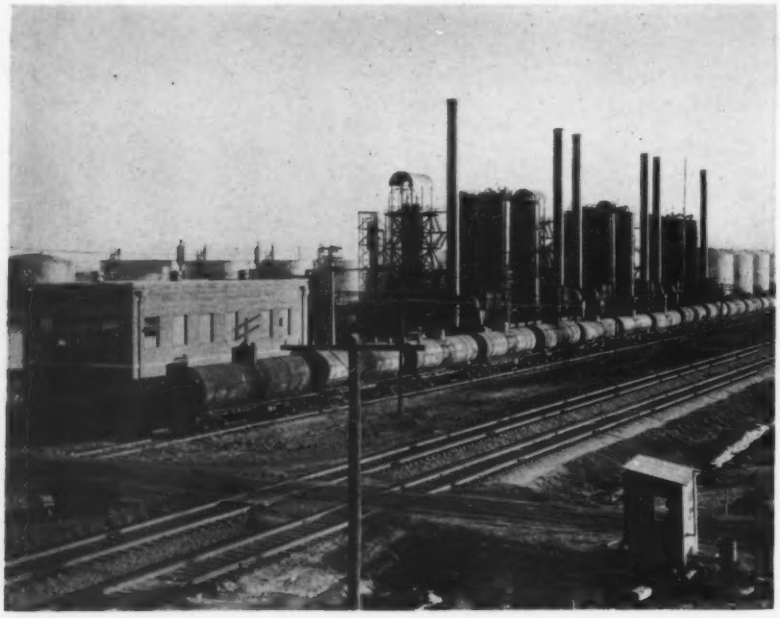
Coke High

The coke yield from the Dubbs units is high, varying from 50 to 55% per

PIPE STILL SKIMMING YIELDS

PANHANDLE CRUDE OIL

GASOLINE		30.4%
	GRAVITY	59° API
	INITIAL BOILING POINT	114° F.
	90% OVER AT	390° F.
	END POINT	435° F.
	COLOR	30
	SULPHUR	0.1%
KEROSENE		7.0%
	GRAVITY	41.5° API
	FLASH	170° F.
	INITIAL BOILING POINT	385° F.
	COLOR	15
	SULPHUR	0.23%
GAS OIL		11.1%
	GRAVITY	37.5° API
	FLASH	250° F.
	INITIAL BOILING POINT	480° F.
	SULPHUR	0.4%
RESIDUUM		50.0%
	GRAVITY	27° API
	FLASH	320° F.
	INITIAL BOILING POINT	536° F.
	VISCOSITY FUROL	29 @ 122
	SAYBOLT	68 @ 210
	SULPHUR	0.68%
LOSS		1.5%
		100.-%



barrel charged, and the wet gas put through the casinghead plant carries considerable hydrogen sulphide thus increasing the problems of casinghead gasoline recovery and quality. The cracked gasoline obtained from the distillate runs apparently about one degree lighter in gravity than cracked gasoline made under the same conditions from average crude residum. So far as we have been able to determine, no additional difficulties are to be encountered in the finishing of the gasoline from this residuum than are met with in the products of average Mid-Continent crudes. The high coke yield, even with the large reaction chambers, holds our actual running time down to between three and one-half and four days.

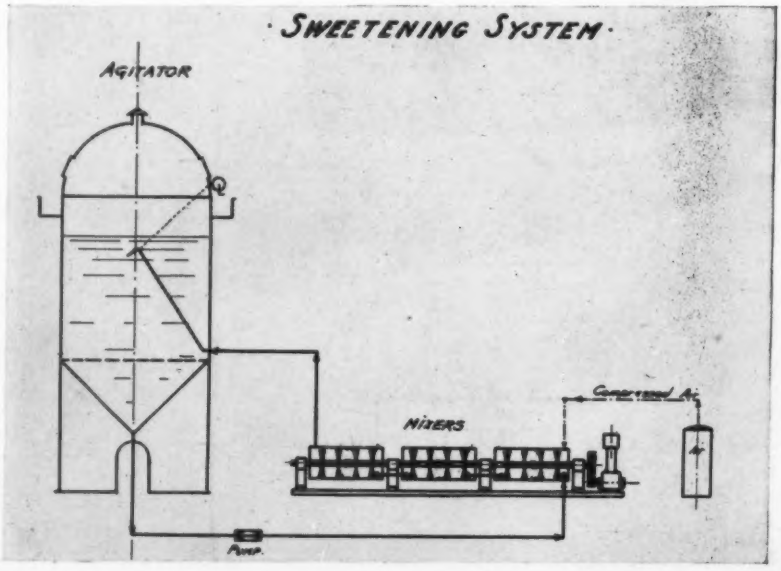
We have made a few runs on one of our stills to liquid residuum, cracking to the point of making from 35 to 40% of gasoline. Our expectation was that a 20 to 24° gravity residuum would show a very low cold test but to our surprise the congealing point still remains comparatively high, ranging between 45 and 60°. We are now carrying on further work in this unit, with the object of determining the operating conditions necessary to produce a residuum with a more suitable cold test and satisfactory carbon content for marketing purposes.

Finishing of Straight Run Light Products

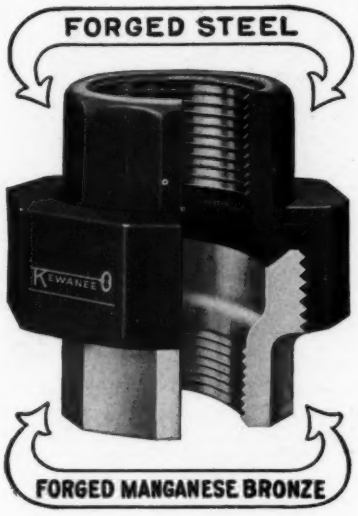
The straight run gasoline offers no unusual decolorizing problem, it being similar in this respect to other Mid-Continent crudes. It must be given a caustic wash or equivalalent treatment to remove traces of hydrogen sulphide gas carried in solution. It is in the sweetening of gasoline that differences are encountered. U. S. Motor gasoline sweetened in the ordinary way requires several times as much plumbite solution as for instance a similar gasoline from Tonkawa crude, and the quantity of sulphur necessary to complete the reaction is tremendously higher, ranging from fifteen to twenty times the quantity. The time required to carry out the operation is several times longer than normal, necessitating in consequence the use of considerably more equipment for the same throughput. Here again a substantial contribution has been made by developments worked out in the plant of the Amarillo Refining Company, who for a considerable time have been following the practice of circulating from and to the supply tank a mixture of gasoline and doctor solution through horizontal mixers with rotating propellers to enforce agitation until the reaction between the plumbite and mercaptans is completed. This method, however, did not work very satisfactorily until they developed the principle of introducing continuously small quantities of air into their mixer. This so improved the results that the time element was cut to less than one half and the chemicals required to bring about the reaction were very greatly reduced. Whether the addition of the air acted chemically upon the plumbite by way of a reoxidation process, or whether the effect is due to a more violent agitation or more intimate contact made possible by the presence of air is a debatable question. In our opinion the improvement was due to both the chemical and mechanical action.

We are using a mechanical mixer for sweetening, built upon this principle. It consists of three 8-foot lengths of 24-inch standard pipe, with heads and stuffing boxes on the ends, the whole resting in a horizontal position in a steel cradle. Each cylinder is equipped with a shaft to which are attached four four-bladed propellers, somewhat similar to the oridinary electric fan. The propellers are so mounted that the throw of the second is opposed to the first, and the throw of the fourth to the third, to give the maximum agitation and contact. The shafts between each unit are connected with flexible couplings to permit of one common power application.

In addition the three cylinders are connected to each other on the side with 8-inch pipe to permit of a continuous flow through the apparatus. The mixer is run at a speed of 100 to 150 r. p. m. The gasoline to be treated is pumped into unit Number 1 in which the compressed air is introduced. The mixture of gasoline, chemicals and air is run from the end of the third unit to the supply tank, in which the air escapes while the chemicals and gaso-



THE KEWANEE UNION



Every single one of them is tested *under water**

NOT one out of a hundred, not one out of ten, but *every* Kewanee Union is separately tested by compressed air under water. This test takes time but it's worth it to be able to guarantee you a sound, leakless union in every Kewanee you may buy.

Kewanee can't corrode because there is nothing that can rust in the iron-to-bronze thread connection.

The ball-joint is forged bronze to forged steel, impressing a harder upon a softer metal to insure a tight seat. This eliminates the necessity for a gasket or inserted parts so that there are just the three pieces to make up a joint that won't leak and can't stick.

Kewanees are made to fit all sizes of pipe from 1/8 to 4 inches.

The Kewanee Union has Five Advantages

1. No corrosion
2. No gasket
3. No defectives*
4. No inserted parts
5. No force needed

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line are continuously recirculated with new air being added until the reaction between the plumbite and mercaptans to form lead mercaptides is completed. Sufficient sulphur is then introduced, still continuing the circulation, to bring about the completion of the reaction to disulphide and lead sulphide or "Blackstrap." The gasoline is then given a thorough water wash. The savings in chemical costs and time element have been very satisfactory. Normally we are treating about 2500 barrels in approximately four hours, exclusive of the time required for caustic and water washing.

Sulphur In Gasoline

Sulphur in the U. S. Motor Gasoline runs about .1%, the allowable limit. Because of low sulphur on our other gasolines, this does not trouble us, but experiments showed that treatment with one pound 66° Beaume Sulphuric Acid after caustic washing to remove hydrogen sulphide reduces the sulphur content materially. The cracked gasolines are safely below the .1% specification.

Another interesting feature of gasoline finishing is the comparative ease of sweetening the more volatile straight run fractions. Cuts of about 410° or lower end point, while still measuredly more difficult to sweeten than a similar product from Northern Oklahoma crudes use but a fraction of the chemicals and time required in sweetening the U. S. Motor Gasoline obtained from the skimming of the same tank of Panhandle crude.

The finishing of the straight run kerosene fraction presents both a decolorizing and sweetening problem. Many experiments were conducted on both laboratory and plant scale, in which the merits of acid treatment followed by fine fuller's earth contacting, split acid treatments in various strengths, acid treating plus filtering through fuller's earth, and sweetening, as well as other schemes were tried out in an attempt to cut down the cost of finishing. Along none of these lines have we been able to reach a satisfactory result which would supersede economically that of using what to us seemed excessive quantities of acid. We have found it necessary to use from six to ten pounds of 66° acid per barrel of kerosene treated, depending upon the starting color of the batch. Undoubtedly ways and means will be developed in the future to improve this condition.

Lubricating Oils and Waxes

Our laboratory indications are that Panhandle crude is entirely unsuitable for the making of cylinder stocks of any kind. Our own practice as described is to crack all of the heavier products, but the Prudential Refinery previously referred to obtains a good yield of high melting point wax from Panhandle paraffine distillate. The high wax content, however, is somewhat of an embarrassment in two ways. It is sometimes necessary to partially recrack the paraffine distillate, and if a normal cold test neutral oil is to be made, the pressing throughput is very materially reduced, even though the wax output may remain satisfactory. The ideal condition for this work is apparently reached, if it is permissible to make a lubricating oil of from 35 to 40° cold test, which means a pressed distillate of about 30° F. C. T. Our opinion is that the trend will be to utilize Panhandle as a source of cracking material and depend on the other crudes for raw material for lubricating oils and wax production.

Value of Panhandle Crude

We have been asked many times our opinion as to the comparative value of Panhandle with crudes of similar gravities of average Mid-Continent type. We won't know actually for a long time. There are too many undeterminable factors to warrant any attempt to more than roughly estimate the difference in value to refiners. True, we can say how much our corrosion-combating chemicals are costing, but we don't know yet whether we are using the right amount. We can calculate the extra cost of treating the refined products but there is no way af determining as yet the cost, or measuring the rate of depreciation of our equiqment. We have made several attempts to estimate this figure, taking into consideration the following factors: That of lower gasoline content than average crude of the same gravity; unavailability as a lubricating oil source; extra cost of cambating corrosion and of treating products, our best guess as to the rate and cost of depreciation on equipment and the cost expressed in money, of loss of capacity due to extra shutdowns. Our figures have ranged from 23 to 28c. per barrel less value to the refiner delivered at his plant. We believe that 25c. is as fair a figure as can be arrived at today.

In conclusion let me say that we do not consider the problem of refining Panhandle crude to be by any means solved as yet. What contributions, if any, we have made to the art have been more in the way of the bringing together and the adaptation and utilization of existing knowledge, and we are indebted to many of our friends in the industry for assistance and information given us. We look for wonderful progress in the near future in the way of better handling of corrosion problems and for still greater reductions in the cost of finishing products.

Let us hark back to the picture of the vast dead salt sea described by geologists. As we attempt to visualize the unknown quantities of crude oils of this type which may yet be produced from that great expanse of 55,000,000 acres, we can see that the industry, in bending its energies to the solving of refining problems of Panhandle, and the mitigating of inescapable difficulties connected with its processing, is developing a technique which will be of continually greater value to it and through it to the American consuming public.

Install Gasoline Plant at Seal Beach

Los Angeles. — The Richfield Oil Company is the first to enter the newly opened Seal Beach producing area with a natural gasoline plant.

The Seal Beach plant of this company, which at this time is about one half completed, will be in operation inside of sixty days. The plant is entirely of Campbell Oil Froth absorption equipment and will consist of the latest type of absorbers, stripper and refluxing systems recently developed by the engineering firm mentioned. The installation will operate entirely on Seal Beach gas at a rated capacity of 20,000 gallons daily.

Improvements Complete

The Torrance Gasoline Company, operating an absorption gasoline plant at Torrance, California, have about completed their improvement program which embraces the installation of a new type of stripper, or still, which is designed to reduce the volume of steam employed in the distillation process, and the installation of a Boner & Sheldon type of absorption tower. This firm is also designing the stripper. The absorption tower is 4 x 25 feet in dimensions and in its installation will replace five absorption towers of various design, the use of which will be discontinued upon completion of the new tower.

B. F. Bart is now assistant sales manager of the oil division of the A. O. Smith Corporation, Milwaukee. The change took him from the managership of the Smith district office in Los Angeles, which is now in charge of Edward A. Livingston.

Mr. Bart has had wide experience in the manufacturing and selling of equipment for the petroleum industry. Following his graduation from Penn State he was with National Tube, the American Iron and Steel Institute and with Standard Seamless Tube Company.

G. G. Brockway, former manager and treasurer of the Warr-Penn Refining Company of Warren, Pennsylvania, has formed the G. G. Brockway Company, also of Warren, for the purpose of handling a new Fuller's earth furnace.

George P. Nisson has resigned from his position with The Vickers Petroleum Company as traffic manager to become associated with Rex Kent of the Kent Oil Company of Norton, Kansas.

Corrosion—An Economical Refinery Problem

*By H. F. PERKINS**
Gulf Refining Company

INTEREST in waste by deterioration of material through chemical action is rapidly increasing. For years many investigators of corrosive action floundered around trying to evolve theories that would explain the erratic and apparently insistent nature of this form of disintegration. Only within the last few years have we been informed, by quite general accord of scientists, of the real mechanism of corrosion, and we are now ready to study each case of corrosion individually on the basis of this information, and depart from impirical methods.

We are interested in corrosion because the scrap pile seems so big, because it is reported that 30 per cent of the iron and steel manufactured is used for replacement of corroded material, because it is generally expensive and often unsatisfactory to replace parts that have deteriorated, because the interruption due to repairs represents a large financial loss, and because failing structures and equipment slow down operations, cause loss and damage by leaks, and endanger life.

While deterioration has been shown to proceed in all cases, one of the first factors confronting us is how long a life is really required. In many structures infinite life would not be economical, and the limit in some instances might be as short as five years. Apparatus which is subject to deterioration only in certain parts, would be most economically treated by giving all parts the same life or in other words the weak parts should be made of material designed to give the same life as the less affected parts.

Examination of the scrap pile reveals the fact that much scrap is due to reconstruction and plant changes, pipe fittings which may have lasted for years if unmolested are found to be unfit for re-use when dismantled; parts of tanks, stills and structures cut off due to remodeling often form an appreciable portion of scrap. It seems hardly necessary to call attenion to the advisability of systematically reclaiming all material fit for further use, and preserving it.

Corrosion in an oil refinery, while in general similar to that in most industries, has a few special classes of its own. The distinct cases are those due to sulphur and its compounds found in all crude petroleums, and the salt water with its portion of magnesium chloride, which it seems impossible to entirely eliminate from the crude.

The action of these two agents is not directly confined to distillation apparatus; since they find their way into the atmosphere and into the water used for cooling, they are responsible for our all around increase in corrosion. While the hydrochloric acid formed from the magnesium chloride in the oil has limited scope for action, there is scarcely any structure free from the associated action of sulphur in some form.

Much work has been done in the reduction of sulphur found in some crudes but this has resulted from the oil having so much sulphur that it is unmarketable. From a refinery standpoint all the sulphur should be removed and this would seem to be a very important research subject in view of the general loss by corrosion, the cost of chemical treatment with its investment, and the slowing down of refining operations.

Corrosion

The actions and interactions which bring about the disintegration of metals as now understood, and the factors controlling these actions are extensively set forth in recent literature on the subject. Corrosion has been expressed as the inclination of a metal to return to its ore, forming soft soluble compounds.

The controlling influences are velocity of liquid, temperature, hydrogen ion concentration, metal potential, concentration of metal salts, formation of coatings, electrical conductivity, overvoltage of hydrogen, and oxygen. In studying corrosion problems these factors will be found and it may be found possible to control one or more thereby reducing corrosive effect without great effort or expense.

The part that such agents as sulphur compounds and hydrochloric acid play is the increase of the hydrogen ion concentration, effect on overvoltage of hydrogen and making metal potential effective. In the atmosphere the factor of oxygen becomes more important.

Refining

The refining of crude petroleum consists of raising its temperature and separating the fractions adaptable for different uses, as they distill off. At the start, dissolved hydrogen sulphide is the first corrosive to come off when present in the oil; as the temperature rises magnesium chloride is decomposed, and the gas HCl comes over. Almost at this same point light sulphur compounds will be broken up with the further evolution of hydrogen sulphide.

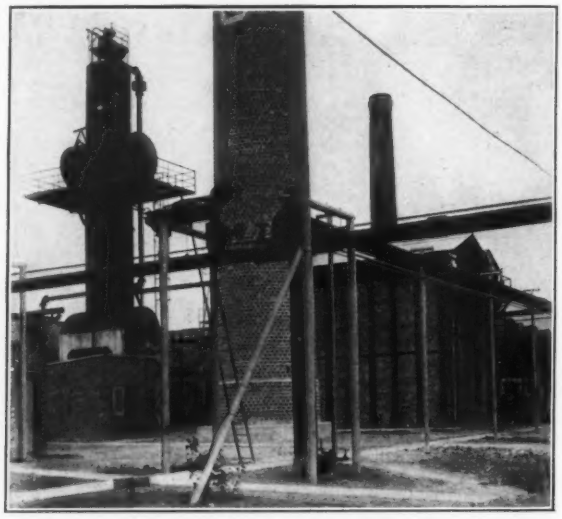
The magnesium chloride is usually completely disposed of when 40 per cent of the oil is distilled over, but the sulphur compounds are so numerous and varied in their composition that they are to be counted on all through the distillation process, and will be found even in the end product, coke.

In accordance with the use ot which different oil fractions are to be put they have to be further refined by chemical treatment, redistillation and filtering. Litharge and other chemicals are used to reduce the sulphur content of some oil fractions. This and sulphuric acid treatment often entail a considerable loss of oil, are expensive, and consume much time, storage space and equipment.

Oils that are put through pressure stills give off hydrogen sulphide, and oils that are burned give off sulphur dioxide. In plants where the uncondensed vapors and gases are compressed in a gasoline recovery plant, these gases contain considerable sulphur and some HCl. The oils stored

*Read before Corrosion group of the American Petroleum Institute, Tulsa, Okla., Dec. 9, 1926.

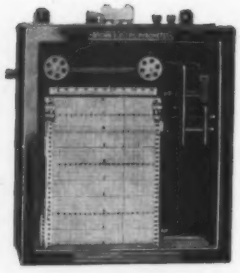
Picture No. 1.—Above is a panoramic view of a quarter year's scrap. In these piles will be found horse shoes, tires, ropes, electric wires, electric conduits, chain gears, pipes, tubes, still bottoms, tank plants, sweater pans, furnace grates, smoke stacks, and so on; worn out, broken corroded, burned and otherwise destroyed.

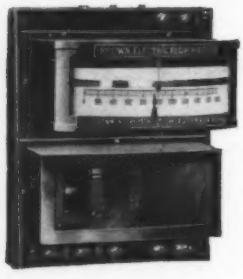


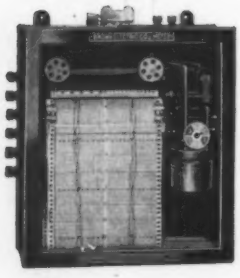
A new tube still (right) and the 85-foot tower (left) which operates off the still at Muskogee, Okla., refinery of Pure Oil Co.

MODERN METHODS

at Pure







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[*To Measure Is to Economize—Pascal*]

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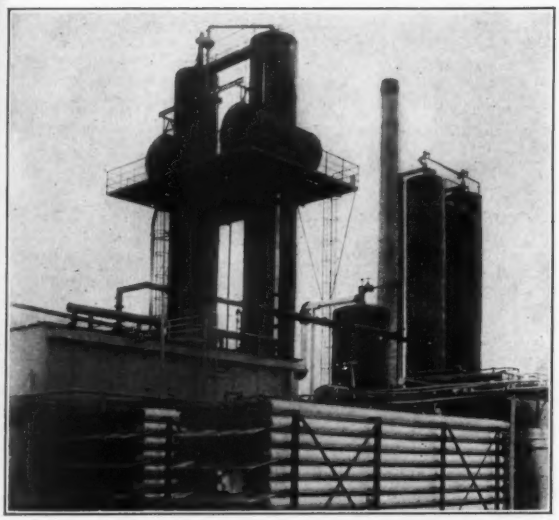

View of new equipment built by Pure Oil Co. to supplement Cross cracking unit installation. In the foreground are the special heat exchangers. At the extreme right is the pressure distillate rerun still operated without firing. Just left of the center are two fractionating towers for the two cracking units.

Oil Company's Muskogee Plant

A recent article in Oil and Gas Journal described this Pure Oil Company Plant as a "new development in skimming and cracking installations. Makes cylinder stocks continuously * * *." It is logical that instruments of advanced design should be specified as an important factor in advanced refining practice. Write for Brown Catalogs covering instruments for any phase of oil refining.

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Picture 2.—This shows the corrosive action on inside of cast iron water box coils from acid water. At the end of the pipe in the foreground the original thickness can be seen, the light colored lining is corroded material, the dark section is good iron. The broken section in immediate foreground shows plainly the extent of corrosion.

in tanks, either as crude oil or fractions awaiting further treatment, give off considerable sulphur gas, the amount depending of ccurse on the sulphur content of oil.

Refinery Corrosion

In a treatise of this kind, expounding on practical experience, it would seem suitable to typify corrosion as acid, high temperature, underwater, and atmospheric. Underground corrosion has similar characteristics to that under water, in that atmosphere corrosion has similar characteristics to that in acid. Water is a necessary agent for most refinery corrosion to take place at normal temperatures.

Crude Distillation

Experience starts with the short life of cast iron condenser coils. The most serious trouble has been found in the gas-oil condenser when steam is used for distillation. The kersoene and gasoline coils corrode slower, due in part to less water being present.

In the gas-oil coil we have in many cases both sulphur gas and HCl, with steam condensing. Insoluble iron-sulphur compounds are attacked by HCl and become soluble, greatly increasing corrosion. Two troubles from this source cause expensive interruption to service, one is the choking of pipe by corrosion products, the other is softening of the pipe which results in cracks or causes pieces to drop out; the destruction can be seen in Picture No. 2. Cast iron corrodes in such a way that the iron goes into solution leaving silica and carbon with some oxide or sulphide as a weak binder. The appearance of pipe is not changed until it is so softened that the liquid flow washes away the corroded material. In the picture the even corrosion may be plainly seen and where for some reason the temperature is a little higher corrosion has completely destroyed pipe.

Tests made on the water coming from this coil, indicated a loss of iron amounting to over 0.7 pound per hour; by neutralization the iron loss was reduced to 0.03 pound per hour.

Further distillation of the crude oil without steam, results in some cracking with further evolution of sulphur gas, and corrosion of parts maintained at temperatures much above 500 degrees F. This corrosion while apparent is not serious, probably because of the small amount of sulphur gas and comparatively low temperatures.

Treated Oils

Many of the various fractions separated during distillation are treated with sulphuric acid or other chemicals and are redistilled with the aid of steam. Those fractions that still contain some sulphuric acid give off sulphur dioxide and other gases which when absorbed in the condensing steam are extremely active. The iron loss by water test in a case where oil carried .25 lb. of sulphuric acid per barrel, was indicated as over 100 lbs. per run even though a large part of the gas was drawn off by steam syphons. The most severe corrosion is experienced on the steel vapor line near the still, where the steam starts to condense. Laboratory tests, using most corrosive water from this still, showed metal resistance in following order: Iron 1, Ascoloy .09, Aluminum 1.17, Copper 1.8, Admiralty 3.3, Monel 3.9.

Cases of this kind may be taken care of by scrubbing the vapors thoroughly with water in a cast iron chamber, passing the acid water off through a large acid proof trap, flowing the oil and its vapors through regular condenser box, and skimming entrained oil from acid water in efficient drainage trap.

In the case of batch stills which require steaming out at end of run, there are acid forming gases present and much corrosion results.

Sweater Pans

The sweating of wax is usually done in iron pans subject to the action of water, steam and oil. A small leak will often cause trouble from loss or discoloration of wax. It is usually a difficult and expensive job to make repairs, and corrosion is quite rapid due to the almost continuous presence of moisture and the high temperature. The oil sweater from wax often contains small amounts of sulphuric acid and organic acids. Tests with monel metal, nickel, aluminum and ascoloy show very little attack under sweater pan conditions. Using one of these metals in thin sheet form as a lining, and spraying on the outside would seem practical.

Pressure Stills

The parts of an oil cracking unit operating at high temperature and high pressure are subject to corrosion and to mechanical strain unusual in other refining apparatus.

Sulphur in the oil charged to pressure stills gives off Hydrogen Sulphide. This gas in its dry state will attack iron at temperatures above 500 degrees F., the action increasing rapidly with increased temperature. The sulphur content of charging oil may vary from 0.1 per cent to 0.4 per cent and from 0.05 per cent to 0.12 per cent in the distillate; there seems to be no fixed relation between percentage of sulphur in charge and distillate. While some action is observed on still tubes, it is most noticeable on plates suspended in the vapors, and here the effect of temperature is plainly seen as the parts at low temperature are little affected while those at higher temperatures are completely corroded away.

Tubes and Plugs

Still tubes are worn thin or have corroded holes in the top while the bottoms of tubes remain the original thickness. Plugs will wear more in one part of still than in another, and while usually the wear is uniform occasionally one will wear more on one side. Shelby seamless steel tubes, series 20-23, are giving good service. Calorized tubes were not found worth their extra cost. Monel metal plugs, while they corrode some, have other advantages, and by proper design give two or three years service. Aluminum Bronze plugs become brittle in the threads causing blowouts. Plugs of some other type of metal jamb in, or are soft and can not be easily removed.

Pumps

Pump bodies are made of steel. Cast iron has been found best for pistons, piston rings, hot packing, liners and valves. The piston rod is made of carburized .30 to .40 carbon, high grade steel oil drawn to the working temperature, giving scleroscope hardness of 75. The ordinary case hardened steel

is good until the hard surface corrodes away; carburizing deepens the hard surface resulting in longer life. Corrosion seems to be a matter of temperature, and the innermost portion of rod (in the oil) corrodes .034 inch to .001 inch in the stuffing box for case hardened steel.

Many alloys have been tried for this work but none has proven of service. Steel piston rings broke quickly, monel rods corroded quickly. There is some corrosion of the pump interior at velocity points, and the addition of nickel and chromium might be of advantage here. In one design of pump copper gaskets corroded quickly, other pumps were designed with gasket protection and copper is satisfactory. Pump valves are solid cast iron balls weighing about 28 lbs. These wear down evenly and give better satisfaction than anything else tried. Valve seats of steel are found servicable.

Piping

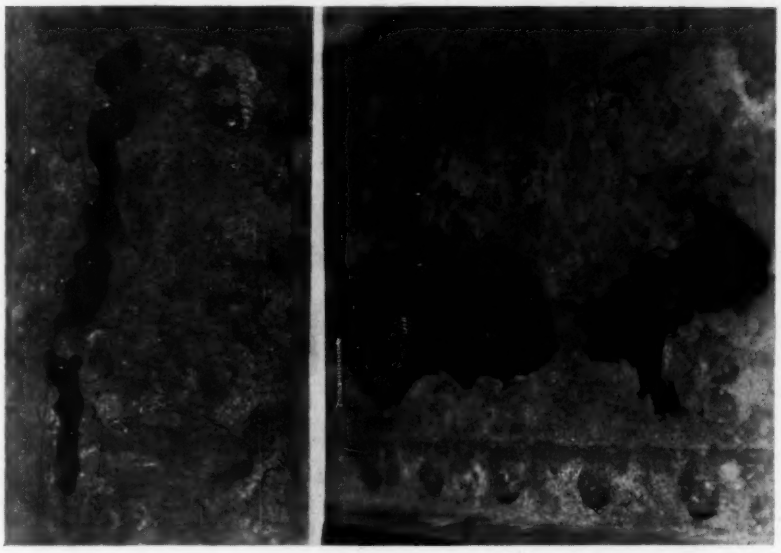
All piping subject to heat and pressure is of the same material as still tubes— cold drawn, seamless steel. There have been a few cases of brittleness, and these were on lines subject to vapor only. Wrought iron under these conditions becomes as brittle as glass. Wrought iron extra strong is satisfactory beyond the pressure zone.

Valves

Valves made of high grade cast steel containing about 2 per cent nickel and .7 per cent chromium, are satisfactory for high temperature high pressure work. Seats and stems are made of rolled chrome-nickel steel The valve on top of separator, used for steaming out, shows the most corrosion.

Separator

In the separator as elsewhere in pressure still system, the parts at highest temperature are corroded most, and while aluminum alloys and chromium iron have shown high resistance to H_2S at high temperature in the laboratory, heavy iron is still used. Metal life is indicated in following ratio from laboratory tests: Iron 1, Ascoloy 3, Enduro, "A" 4, Aluminum Sheet 11, Enduro "T" 59, Aluminum Alloys "3SO", "3SH" "2SH", 180. The vertical wall of a separator shows little corrosion but usually has a scale which gives on analysis, Iron 58.18 per cent, Sulphur 7.04 per cent and Carbon 16.23 per cent, the iron representing .005 inch depth loss per year. Parts that gather a fine carbon or coke deposit are protected against excessive corrosion.



Picture No. 3.—Here are steel plates corroded by water

Calite, a Nickel-Chromium-Iron Alloy, is used in stills for supports, and while it distorts it does not burn and can be straightened by using the proper method.

Durolcy plates suspended as furnace baffles stand the temperature without oxidizing, but will warp badly unless properly supported.

In general, corrosion of pressure still equipment is most severe where gases and vapor may be localized or are free from the oil. Chrome-nickel alloys are most servicable in general, cast iron is satisfactory where great strength is not required. Constant expert supervision is responsible for anticipating failures in this equipment.

Tube Stills

Tube stills show somewhat the same effect as pressure stills tho not so severe, and as the pressure and temperature is lower and the charge somewhat different, the active corrosive agents are probably not the same. Brass plugs on these stills do not give best service.

Where steam is used very severe corrosion occurs on the steel vapor line at the point where steam condenses. A monel metal sheet lining in vapor line where corrosion is most active has given promising results. This corrosion is probably due to H_2S and HCl in water, when distilling crude oil.

Gasoline Recovery Plant

Gas containing vapor from many of the distillation processes is compressed, or passed thru oil to recover any light gasoline present. The sulphur present in this gas from different departments averages as follows: Crude Stills, 1 per cent, Coke Stills 2.5 per cent, Topping 3 per cent, Cracking 0.2 per cent, Rerunning 1.0 per cent. A small amount of water vapor in the gas is condensed by compression and cooling coils of wrought iron are badly corroded, the products causing complete stoppage in a short time so that pipes, valves and fittings have to be blown out with steam frequently. The products of corrosion are iron, oxide, iron sulphide, iron sulphate and free sulphur. Water scrubbing in an acid-proof tower removes a large portion of sulphur.

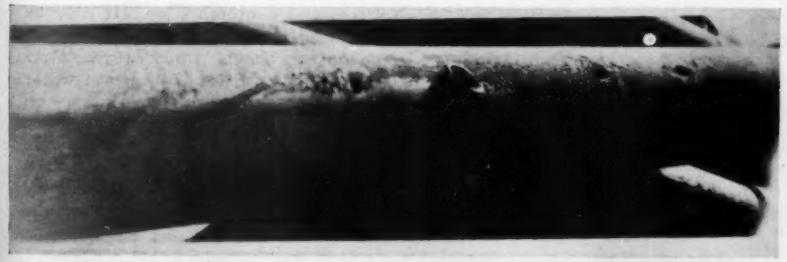
Where the absorption system is used the oil soon becomes saturated with sulphur which precipitates wherever the oil is expended through a valve, probably due to reduction in temperature. A reduction to 32 degrees F. has been found to cause precipitation of 6 per cent of the sulphur in this oil as free sulphur. Sulphur may be removed from the gas by a special washing process, but at present the method is too expensive for this application.

In a test of water saturated with H2S and the life of iron taken as 1, monel metal was 25, aluminum was 40, and admiralty metal was 43.

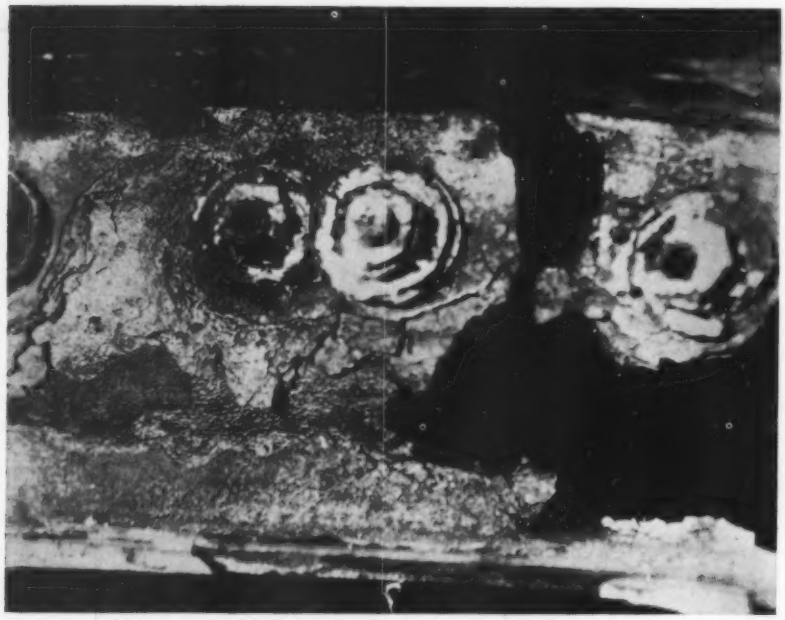
The gas holder, sealed with water, is attacked near the water line, more severely inside than out. The outside corrosion is due to oxygen and gases in the air but inside, mostly to sulphur gases. An oil layer on the water is being tried to keep the gases out of the water.

Gasoline Condensers

Where gasoline is distilled off with



Picture No. 4.—Here is a good illustration of steel pipe corrosion



Picture No. 5.—This shows oxidation at high temperatures

steam, brass tube condensers are sometimes used. Sulphur being absent, there is no corrosion but with sulphur present admiralty metal tubes are readily attacked. Admiralty metal coated with tin is being tried in this connection. The cast iron heads of these condensers are severely eroded by the high velocity action of vapor emerging from the tubes, the vapor direction is reversed at each pass by these heads and the iron has been eroded nearly an inch deep in about two years. Removable linings of steel are now being used. There is considerable corrosion of these condensers by water, which will be taken up later. No corrosion has been experienced with cast iron coils in this connection.

Tanks

Sulphur gases combined with moisture condensed from the air cause severe corrosion on inside of storage tanks. Scale from roof of tank which exploded, gave following analysis:

Iron sulphate 1.84 per cent; total sulphur 15.57 per cent.

Iron sulphide 13.58 per cent; total iron 55.04 per cent.

Free Sulphur 7.26 per cent; loss by ignition 20.70 per cent.

Many mysterious tank fires in the past may have been caused by the formation of these compounds, for while they are formed under moist conditions, a sudden drop in air temperature with accompanying low humidity will dry off the scale, and rapid oxidation will result in high temperatures in places. Cast iron corroded under water will show the same effect when exposed to the air.

Paint lasts but a short time on the inside of tank roofs, but possibly spraying, or lining with a resistant metal such as tin or aluminum would eliminate this trouble. The best plan would be to eliminate gas space under roof. Agitators are subject to this same trouble but are more accessible and can be kept painted.

Where floating roofs are used the inside of tank above roof corrodes badly, due undoubtedly to the concentration of gases on this surface.

The breather lines for tanks are badly corroded, and the flame arrester screens of monel metal have to be renewed very often, as both air and corrosive gases are continually moving through these pipes and screens.

Monel metal ropes controlling swing-pipes in tanks, often are seriously corroded when they come in contact with water associated with sulphur compounds or oils containing sulphuric acid. Monel metal lasts twice as long as steel but at best the life is short.

Tank bottoms have given much corrosion trouble from the water settling out of oil; this is overcome by a three-inch layer of well mixed 1:2:4 cement, which is also applied to water box bottoms. The use of iron traps with acid proof lining has greatly reduced this source of corrosion, especially on running tanks, as the water is drained off at end of condenser coil before it can reach the tank.

The above outlines the main sulphur and acid corrosion peculiar to petroleum refining. While percentages of corrosive elements are small, their quantities are sufficient for extensive destriction. In a large refinery the production of HCl gas from salt in the crude, may average 200 lbs. a day, and the sulphur may amount to 90 tons a day, while on the other hand, almost as much pure sulphur will be required for manufacture of sulphuric acid used in treating. Sulphur is active further in connection with atmospheric corrosion on account of large quantities of H_2S and SO_2 given off by tanks, stills and furnaces; the sulphur going into combustion approximates nine tons a day. Corrosion by sulphuric acid and other standard chemicals used in refining is not treated here as their effects and methods of handling are generally known.

High Temperature Corrosion

The corrosion of pressure still and other equipment when above 500 degrees F., by H_2S, comes under this head but has been treated above. Other high temperature corrosion is found in furnaces. Pressure still tubes or others, and still bottoms on which an insulating deposit of coke or salt forms, may reach furnace temperature; as this may be anywhere from 1300 degrees F. to 1400 degrees F., iron will readily oxidize, because appreciable oxidation takes place at as low a temperature as 900 degrees F. With oil flowing rapidly over and in contact with metal, the metal temperature will be nearer that of the oil than of the furnace, but a small deposit of salt or coke will prevent the metal from being cooled by the oil.

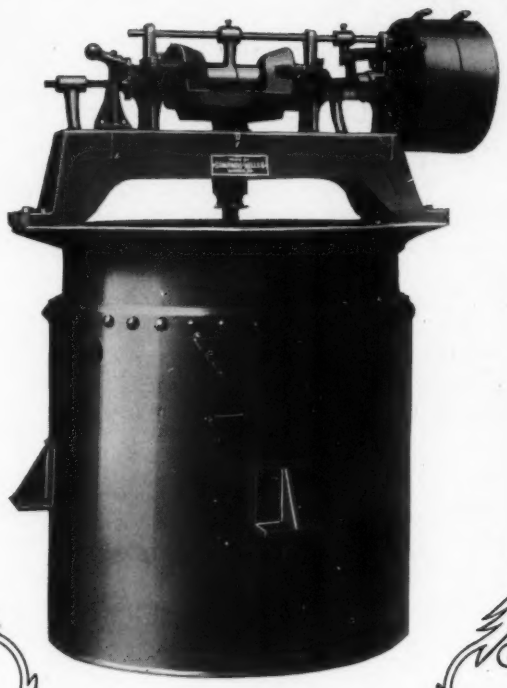
In the concentration of heat in some furnaces, the temperature of metal may be high enough to cause some cracking of oil at a certain point with the gradual building up of a local deposit which, after several days or perhaps weeks, results in burned iron. This trouble may be initiated by a local rate of vaporization great enough to separate the oil from contact with the metal, which would allow the metal temperature to increase causing incipient cracking of oil that occasionally might reach the spot. This effect may also be caused by improper application of steam in the still. Oxidation at high temperatures is shown in pictures No. 5 and No. 6. Ascoloy, or iron containing over 14 per cent chromium is said to resist oxidation at the temperatures of ordinary still furnaces and would seem promising material for pressure still tubes and coke still bottoms.

Brick-work in furnaces gives little trouble unless the fuel contains alkali or acid sludge. Ordinarily the sulphur in fuel oil seems to give little difficulty, but alkali will cause fire bricks at high temperature to melt in a very short time, and some trouble has been experienced in the past. Chromium containing fire cements seem to resist the action of caustic at high temperatures, but have not yet been tested thoroughly.

Under Water Corrosion

This problem is one of local significance, is characteristic of water supply sources and contamination. It may be interesting to study the curves on accompanying sheets, where a year's record of maximum and minimum water and air temperatures are shown on sheet No. 21, and the average weekly salinity together with maximums are shown on sheet No. 22. This was a particularly dry year. Much refinery waste finds its way into some of the cooling water.

The fire lines are giving the most serious trouble, but mainly from outside corrosion and cracks. The soil is



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THIS is merely representative of the hundreds of metal containers made by the versatile manufacturing facilities of the Struthers-Wells Company.

Whether the construction calls for welded seams or riveted joints, mixing kettles or cracking stills, the Struthers-Wells organization has the resources and skill to meet any specification in the refinery field.

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Picture No. 6.—This shows the hard oxide scale formed on seamless steel tubes at high temperatures.

mostly clay and is practically continually wet, but elementary tests have shown the water in ground to be neutral. The corrosion of these lines takes place at points which correspond with the imperfections or loss of protective coating on new pipe, and where coating is thick and intact no outside corrosion is found. Inside corrosion is to an even depth, generally one quarter thickness of pipe, which shows that the protective coating is not impervious to water. The nature of this corrosion is shown in picture No. 7 where at A the metal is well protected outside by coating, and at B corrosion has progressed through pipe wall.

Many of these failures are accompanied by extensive cracks in the cast iron and the cause of this has not been determined, it may be due to structural strains or to disrupting corrosion products. Out of 23 failures, 10 had corroded holes of about 8 sq. in., in 3 cases pieces were broken out without apparent corrosion, 3 were cracked with but slight corrosion and 7 were both badly corroded and cracked. These pipes were in the ground from 11 to 13 years and were scattered over plant. Cooling water lines under the same conditions, except lower water pressure, have given no trouble and show very little inside corrosion, which suggests that pressure may have something to do with the penetration of water. Pipe coatings vary greatly in texture, thickness and evenness. These coatings are soluble in strong acid or alkali. A compound of wax tailings is being applied to new pipe in an endeavor to cover the bare and imperfect spots. It was found that the pH value of water in fire mains could be increased to 9.5 by adding caustic soda, at an expenditure of about $6.00 a day. With this and better outside protection the life of pipe should be increased many fold.

Analysis of Inside Loose Scale

Specific gravity 2. 8%, 1.95; Moisture 20.6%, 4.4; Silica 5.8%, 8.0; Ferric Oxide 62.4%, 67.4; Free Sulphur 7.9%, 10.1; Chlorides 0.5%, 1.5; Sulphate 1.3%, 1.3; Sulphide 2.9; Carbon, 0.5%, 4.4.

Analysis of Corroded Material

Silica 23.5%; Ferric Oxide 60.2%; Carbon 8.9%.

From determination of iron carried in water the loss was estimated as 150 lbs. each 24 hours.

Water

Chlorides and hydrogen ion concentration of various waters used is given below:

Source	Use	Chlorides Grams per liter	P.H
No. 13 P. H.	Cooling and Fire	6.5	3.6
Alligator Bayou	Water Supply tributary	1.7	Acid
No. 72 P. H.	Cooling	.9	6.7
No. 3 Reservoir	Boilers	.3	6.7
Treated	Boilers		14plus
Neches River	Boilers	.1	7.0
Drilled Wells	Low temp. cooling (very corrosive)	9.9	8.1
Tanker Ballast	From Savanah, Ga.	29.6	8.1
Tanker Ballast	From Delaware River	11.2	6.9
Fort Worth drilled wells	(corrosion very slight)	0.15	8.3

Water temperature will average 91 degrees F. over the summer months and 60 degrees F. during the cooler months. Examples of water corrosion are shown in pictures No. 3 and No. 4.

Pump impellers have a comparatively short life, and it is interesting to note results in different locations; at Baytown on Galveston Bay it is reported that:

Acid Bronze lasted 2 months.
Cadmium coating lasted 2 months.
Everdure gives prospect of one year.
Everbright has a little better prospect.

On the Neches River above Port Arthur:

Cast Iron lasted 5 years.
Acid Bronze lasted 6 years.

At Port Arthur acid Bronze impellers last five years.

In cases where bronze parts inside of pump were changed to cast iron, this iron corroded rapidly due to electrolytic action.

Water sprayed coolers of wrought iron pipe as used in gas compression plant, oil cooling and refrigeration corrode very rapidly, due no doubt to atmospheric exposure. NO-OX-IDE is used for protecting threads and return bends in many of these cases.

Tank roofs of steel that are water sprayed during warm weather, are kept painted and last several years. Roofs containing water wells are corroded most near hatches and other openings where gases from oil leak out.

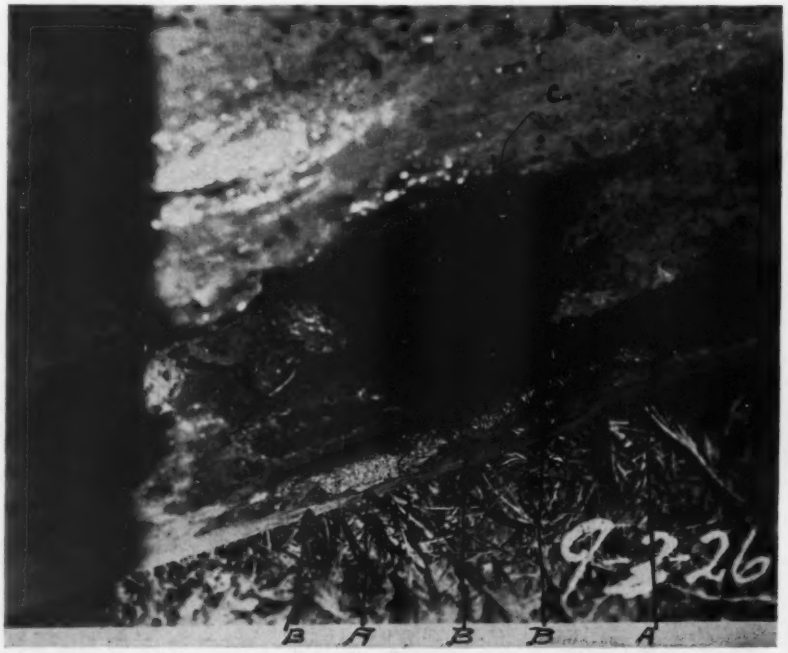
Condensers

Water box condenser coils of cast iron have a life of many years as far as water is concerned, and usually fail from inside corrosion first. Where bolted pipe is used the steel bolt heads disintegrate in a few months causing serious leaks; monel metal bolts will outlast life of pipe. On testing bolts against cast iron and steel plate for electrolytic polarity, there was always considerable difference of potential but the polarity was not always consistent.

As in other cases where volumetric water cooling is used, corrosion is much more rapid at the top of the system where temperatures are higher and gases in solution are concentrated.

Condensers using admiralty metal

(Continued on Page 97.)



Picture No. 7—Cast iron fire line showing even depth of inside corrosion and selective outside corrosion. At AA the iron has been properly protected. At B, B, B, corrosion has preceded without restriction, at C the soft nature of corroded iron can be seen.

METRIC METERS

At the Oil Capital's Headquarters

It is the logical result of experience in the outlying oil and gas districts, that these Metrics should be installed in the very heart of Tulsa at the Mayo.

From this famous gathering place for the industry, out to the most isolated leases in Oildom, thousands of Metric Meters are reporting production and consumption of gas and oil with the characteristic accuracy for which they are renowned.

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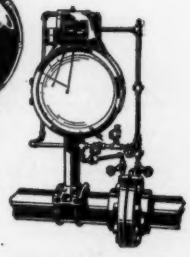

METRIC METAL WORKS

of the American Meter Company-Inc.

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Mention Where You Saw the Advertisement

Modern Fire Fighting in Oil Refineries

*By FRANK A. EPPS**
Tide Water Oil Company

THE oil refiner has a special fire fighting problem of his own. He know how to meet the emergencies that arise in combating oil fires. If he is a wise refiner he will be forearmed, and prepared to meet unusual fire situations.

Possibly no other word than "preparedness" more aptly expresses the fire fighting problem in oil refineries. A great interest has developed in this subject in the oil industry. Practically all of the trade associations in one form or another are carrying on among their membership an organized method of controlling and preventing oil fires.

Today modern fire fighting in oil refineries begins before the fire occurs. Most of the larger oil companies and many of the smaller ones maintain continual fire inspection and prevention service. As practically all of the causes of oil fires are well understood, their preventoin is simply a process of applying known measures and using recognized safe practices.

Watch Construction

The instances are rare when fire attacks oil storage and handling equipment of modern design. Most oil fires are directly traceable to the use of construction which today is known to be hazardous. For plants built in accordance with recognized good practice, the fire frequency is exceedingly low. For plants that have in addition suitable appliances for handling oil fire, a trained fire brigade and good plant maintenance, the fire risk becomes equal to the preferred class of industrial risk.

About two-thirds of the total fire loss sustained by oil properties consists of the destruction of oil tanks and their contents. Tank protection, therefore, is the principal item towards which the oil refiner must direct his attention, in order to safeguard his plant. Lightning is the cause of approximately 55 per cent of all tank fires. Ignition resulting from exposure to fires that have originated in other structures is the direct cause of 33 per cent of the tank fires and the remaining 12 per cent are ignited in an unknown manner; careless operation, and static electricity probably being the principal causes of fires in this classification. Of the tanks ignited by lightning, it is of interest to note that approximately 93 per cent of them are not gas tight. Most of them are equipped with wooden roofs. A detailed analysis of the fire records of the all-steel gas-tight tanks which were ignited during the period 1915-1925 gives evidence of unprotected vent openings. The fire records also indicate that tanks of this construction most frequently go through extremely severe conditions of fire exposure without ignition. It is evident, therefore, that the installation of all-steel, gas-tight tanks, plus their proper maintenance, practically eleiminates the bulk of the fire danger.

Of all the tanks lost by fire in the period 1915-1925, 58 per cent contained crude petroleum, 20 per cent gasoline, 17 per cent kerosene and like oils, 2 per cent fuel oil and 3 per cent miscellaneous oils. Thus, the majority of oil tanks that burn contain crude oil. This is to be expected, because of the fact that fire danger and wooden tank roofs are synonomous and such tanks are used principally for crude oil.

The annual frequency of fires per 1,000 tanks during the ten year period 1915-1925 was as follows:

The relative safety of the steel roofed tank is evident.

Contents	Wooden Roofed Tanks	Steel Roofed Tanks
Gasoline	17.9	0.26
Kerosene	15.2	0.28
Crudes	4.15	0.64
Fuel Oil	1.44	0.45

In order to prevent fire in tanks, the following are the principal considerations to be borne in mind:

Construction

Tanks should be set upon firm foundations, re-inforced concrete slabs being preferable for all permanent installations.

Tanks should be constructed of open hearth steel equivalent to Structural Grade "A" as specified by the American Society for Testing Materials. The absence of a specification on steel permits the manufacturer to supply almost anything, and this has, in certain cases, resulted in failures in the tank shells shortly after construction. Vertical tanks should be designed for a factor of safety of not less than 2.5 based on the tank being filled with water. Top angles should be located inside rather than outside in order to permit calking of the top angle joints. Roof plates should be not less than 3/16 inch in thickness as it is impossible to secure tightly caulked riveted joints with thinner metal. In this connection it should be noted, however, that a number of tank builders are now welding the roof seams and with this form of construction it is possible to obtain a tight roof with thinner metal.

Roof Fittings

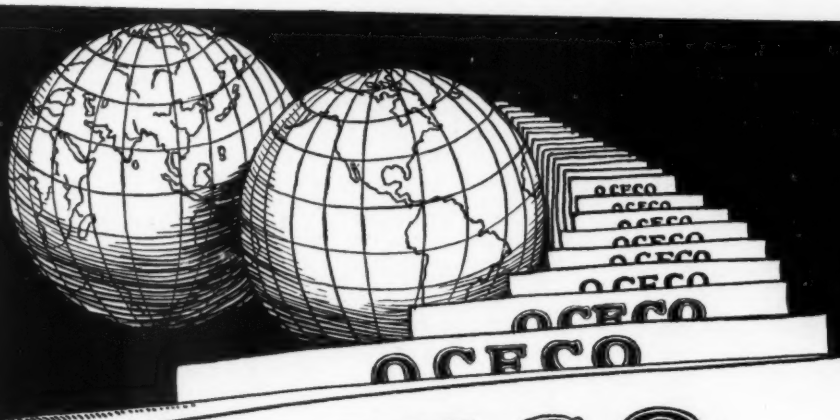
Gauge hatches should close by weight only and should be so designed that they will lift and vent the tank prior to roof failure, should pressure be built up in the tank, perhaps due to a fire in an adjoining structure. Such hatches, however, should be gas-tight when they are in closed position. All other openings in the tank roof, such as explosion hatches, manholes, etc., should be securely gas-tight. Venting connections for tanks containing crude oil, gasoline and other volatiles should preferably be of the sealed type and should have ample capacity to relieve any pressure or vaccuum which can be developed within the tank under the most abnormal conditions of pumping out and simultaneous cooling from a shower on a hot day. Such vents should be equipped with suitable flame arresters and in this connection it should be noted that metal screens arrest flame only by reason of their ability to conduct the heat away very rapidly to adjacent solid metal parts, thereby preventing the formation of ignition temperatures on the other side of the wire screening. If the distance from the central part of the wire screen to solid metal is too great, a single thickness of screen will not serve, but a double or triple thickness is required. Beyond certain dimensions even a triple thickness of wire screen may be satisfactory. The actual limitation of wire screen flame arresters has not been fully determined. The Underwriters Laboratories of Chicago, Illinois, conducted an extensive investigation in 1919 in conjunction with the E. I. Du Pont de Nemours Company. A number of oil companies have performed some experimental work in this connection, but the investigation works to date is incomplete. At its meeting this week in Tulsa, the American Petroleum Institute will consider the advisability of devoting an appropriation for further research in this direction.

All remaining holes through the roof plates should be effectively closed, for example of a swing pipe connection is employed, a stuffing box should be provided where the cable passes through the roof.

Wooden Roofed Tanks

Where wooden roofed tanks are employed, very careful consideration should be given to the advisability of replacing them with steel roofs. Where this cannot be done, the wooden roof should be placed and kept in excellent repair, and an overhead system or network of grounded conductors should be supplied and connected to grounded metal towers located at a suitable distance away from the tank or tanks protected. This system of lightning protection is in use today in California for oil reservoir pro-

*Presented to the American Society of Mechanical Engineers December 9, 1926, at New York, N. Y.



OCECO

There Must be a Reason

—why Oceco Equipment is used by leading companies the world over

Among Oceco users are—

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Barber Asphalt Co.
Barnsdall Refining Co.
Beacon Oil Co.
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Calpet Refining Co.
Canfield Oil Co.
Carter Oil Co.
Cities Service Refining Co.
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tection and has been described in detail in the trade publications. The overhead network of wires will relieve the roof of the induced charge effect which occurs during a thunder storm and is responsible for ignition of many wooden roofed tanks. The grounded steel towers, if properly located, will receive and safely handle direct hits which might otherwise strike the tank.

Another form of lightning protection for wood roofed tanks provides heat insulation for the wood deck by which the tank is made gas-tight at the same time. In addition to this, a network of grounded conductors is stretched over the top of the tank and supported by steel posts affixed to the tank shell. Unquestionably this "Faraday Cage" gives excellent protection from induced charges, and also provides a fair degree of protection against direct hits.

Fire Walls

Fire walls should always be provided around crude tanks and should be:

(a) of a capacity equal to that of the tank surrounded, unless adequate drainage to a sump of like capacity is provided.

(b) Located not nearer to the shell of any of the enclosed tanks than the diameter of the largest tank enclosed, and in any case not less than 50 feet.

(c) Provided with a suitable coping projecting inward to turn back boil-overs.

The construction and function of the coping referred to, was described very completely in a paper presented by Mr. H. H. Hall of the Standard Oil Company of California to the American Society of Civil Engineers last year.

For other than crude tanks, fire walls are so seldom required during actual fires that their construction is unwarranted except under conditions of an unusual nature wherein the exposure of large values justifies extraordinary measures.

Grounding

A ground connection of some kind is necessary. However, the earth under the bottom of most tanks is usually moist and is a sufficient ground, even in exceptionally dry regions. In addition, the pipe lines connected to the tanks are usually embedded in moist earth at a point not far from the tanks. However, for tanks resting on concrete slabs and connected to an above ground system of piping, an electrical ground is essential. This also applies to tanks resting on cinders, wood or other insulating foundations. Grounds are most frequently obtained by driving iron pipes to permanent moisture and connecting them by means of substantial copper cables to the shells in the tanks. The use of "Paragon" cones is also to be recommended. These are baskets or cones made of perforated sheet copper. It is customary to fill them with charcoal (which acts as a moisture retainer) and the filled baskets are deposited in holes made by a fence post borer in the vicinity of the tanks, the holes being extended to the depth of permanent moisture. Heavy copper cables connect the tank shells to the buried copper tanks.

Fire Protection

As before noted, the probability of fire in all steel gas tight tanks is very remote, and except in cases where large values are involved or where other considerations warrant a considerable investment in fire protection equipment, it should not be necessary to make any special provision for fire protection. Proper tank construction and proper maintenance provide in themselves very complete protection.

However, in large plants, where fires originating in other structures must be handled, it is customary to provide both steam and foam protection for the tankage. The adequacy of steam installations as they are designed and installed today is very questionable, as was developed in a paper read by Mr. G. O. Wilson in January, 1926, before the American Petroleum Institute's Convention at Los Angeles.

The only effective fire extinguishing agent for all tank fires is foam. Where properly installed and maintained such fire extinguishing system will always give a good account of themselves. The use of foam in this country is comparatively recent, the entire development being only about 12 years old. Nevertheless, today there are very few modern refineries which do not have foam systems. Almost without exception, where they have been installed in accordance with the standards of design which are outlined in the following pages, they have operated successfully and have saved much property that would have otherwise been lost.

Several other types of tank fire extinguishing equipments have been and are being developed. These utilize water sprays, carbon tetrachloride and carbon dioxide. As applied to oil tanks, these equipments are still in the experimental stage and have only a record of test fires to their credit.

Operation

Under no circumstances, should an excavation be made under a tank in order to repair a leak in the bottom, unless the tank has been entirely emptied. Failure to observe this precaution has resulted in failure of the bottom plate and loss of contents of tank, not to mention narrow escape from drowning on the part of the men around such excavations.

Gauge poles should be fitted with brass hinges and shoes instead of iron so as to eliminate possibility of mechanical sparks. Gauging tapes for the same reason should be fitted with brass plumbbobs. The gauger should be instructed regarding the necessity of keeping all hatches closed and violation of this rule should be sufficient reason for discharge.

Before making repairs on any tank a gas free certificate should be obtained from the laboratory. The use of electric extension lights should be prohibited in tanks that have previously contained volatiles, unless the most rigid procedure has been followed in cleaning and "gas-freeing" the tank.

Inspection and Maintenance

In the relatively few cases of ignition of all steel gas-tight tanks, it has been observed that such ignition resulted directly because of some defect in equipment which rendered the tank sub-standard at the time of ignition. This is a fact of prime importance emphasizing as it does the necessity for continual tank maintenance. Every Oil Company should, if this is not already its practice, institute at once careful and periodical inspection of such equipment. Records of these inspections should be kept and the defects found should be promptly remedied.

The National Petroleum Association has already instituted among its membership a "Fire Marshals' Association." The member companies have appointed in their refineries a group of men known as Fire Marshals who make periodic inspection of all tanks and equipment. These men report to someone in executive authority in their respective plants. Inspections are made and reports are prepared on standard forms. While on the subject of inspection of tanks, it is of interest to note that the N. P. A. Fire Marshals likewise inspect the fire protection equipment and all structures, such as buildings, stills and loading racks.

Next to oil tanks, the greatest fire risk in oil refineries is to be found in the distillation equipment. Fire prevention around such equipment can be summed up in one sentence: Careful operation and first class upkeep.

Most frequently, fires occurring in the distillation process are caused by small oil or vapor leaks. They are usually put out with hand extinguishers, steam jets, water hose or by pumping out the still with negligible loss. Occasionally, however, something lets go, a still bottom splits, a high pressure drum explodes, or an oil line breaks, and a big fire is under way. In order to handle fires of this type, the distillation unit should be designed and installed with the following three points in view:

1. Provision of facilities for the rapid removal of the oil in the burning still and in nearby stills.
2. Provision of facilities for confining the spread of the fire.
3. Provisions of adequate fire extinguishing equipment.

Dealing with these in the order named, it is evident that one of the simplest and most effective ways of handling a serious still fire is quickly to pump out the burning still and those which are menaced. Therefore, the importance as a fire protection measure of having large pumps for this purpose and large pumping out lines is apparent. It is essential, however, that all valves in the pumping-out line shall be equipped with remote controls, so that they can be operated safely and surely—usually from in back of the of the condensers. Serious consequences may result if during the excitement the still is pumped out without having top steam turned on. It is quite probable that failure to observe this point has been responsible for many of the still explosions and the resultant loss of life which have accurred during such fires. Since the steam line is so important, its valve control should be just as accessible as the pumping out valve control, and its installation should be reasonably secure against injury.

In order to limit fire spread, it is im-

Decreases 'Up-Keep' Costs

When the drilling engine is started up after a shut-down, there might be a water hammer or knock, which often results in broken cylinder heads, unless you have provided in some way for the condensation from the steam lines.

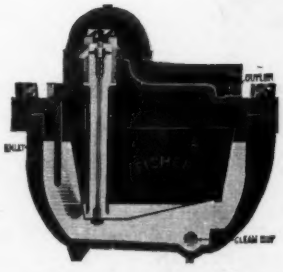
The FISHER Steam Trap No. 33, when hooked into a steam line, to a drilling engine in the field, decreases up-keep costs and increases the efficiency of the engines by providing dry steam at all times. A great many of these FISHER Steam Traps are in use in the oil fields and are giving gratifying results everywhere.

To facilitate matters for the operator these steam traps are now crated in a novel manner which allows connections to be made and the trap put into service without uncrating, thereby affording 100% protection to the trap under all conditions.

Illustration shows a Fisher Steam Trap hooked into a steam line to a drilling engine in the field. The efficiency of the engine is increased as dry steam is assured through use of the trap.

The Fisher Governor Co.

1309 Fisher Building
MARSHALLTOWN, IOWA



Fisher traps are strong, simple and positive acting. A main feature being, they have only two parts susceptible to wear, the valve and the seat. These can be changed without dismantling trap or disturbing pipe connections.

portant to provide, as far as practical, fire walls around every battery of stills. Frequently, the near walls supporting the condenser boxes may be used as part of this surrounding fire wall. It is further desirable to break up the fire areas in and around the units of any battery, so that a flood of hot oil pouring from a break will endanger as few adjoining stills as possible. Catch basins and sewers should be connected to the areas so enclosed and such connections should drain to remotely located separator ponds.

It frequently happens that small fires assume serious proportions because oil and vapor lines are improperly supported. The collapse of their supporting members and consequent breakage of lines or fittings permits the contents of these lines to drain stills and add fuel to the blaze. It is of prime importance, therefore, that crude charging lines, flow lines, vapor and reflux lines, fractionating towers and such equipment be supported by structural members properly insulated. Poured concrete made of limestone aggregate and having a thickness of from three to four inches is most suitable for this service. Complete particulars regarding the degree of fire protection afforded by different types of heat insulation may be obtained from "Fire Tests of Building Columns" published by the Underwriters Laboratories of Chicago in 1919.

Fire protection equipment around stills usually consists of first aid fire extinguishing devices, as two and one-half-gallon foam extinguishers and 40 gallon foam chemical engines steam hose fitted with long extension nozzles, water hydrants and hose, and foam hydrants and hose.

Foam Systems—Dry Chemical Type

Foam systems are of two general types, namely, the dry-chemical portable type and the stored-liquid stationary type. The former is a very recent development and its limitations have not yet been fully determined. In general, this type of installation seems to fill the need for foam equipment intermediate both in capacity and in cost between the portable wheeled foam fire extinguishers and the stored-liquid stationary type of installation.

The dry-chemical equipment consists essentially of a so-called "foam generator" which weighs about 110 pounds and requires from 60 to 100 pounds of water pressure for its successful operation. A line of 2½-inch hose is extended from a water hydrant to the generator and 50 to 150 feet of hose of the same size connects the discharge of the generator to the nozzle. The generator itself is essentially a water ejector, which is mounted on a portable frame and equipped with a funnel or hopper. The vacuum surrounding the constricted water stream in the ejector draws the dry-chemical contained in the hopper into the water. The component chemicals in the presence of water immediately dissolve and re-act, so that a stream of the resulting product—foam—issues from the nozzle. The dry-chemical powder consists of sodium bicarbonate, ground aluminum sulphate, powdered foaming extract and a small percentage of inert clay, all ground to a fine mesh, thoroughly mixed and packed in 40-pounds cans, hermetically sealed. These cans are supplied with quickly detachable covers, and in case of fire, the contents are poured into the hopper of the generator at the rate of about two cans per minute.

The effectiveness of this type of equipment is measured by the following:

1. An adequate supply of water at the required pressure.
2. The quantity of dry chemical in storage. Obviously this device can supply a foam stream as long as the water supply and the supply of dry chemicals last.
3. The auxiliary connections which are available to assist in discharging the entire output directly on the seat of the fire.

In the writer's opinion, the limit for one generator under good conditions is about 500-700 square feet of burning oil surface. On a fire much larger than this, the foam will probably be consumed as rapidly as it is applied. The minimum quantity of dry powder in storage should be sufficient to keep all generators in operation for a period of about one hour.

Foam Systems—Stored Liquid Type

This type of foam installation provides storage containers or tanks for two chemical solutions (Solution "A" and Solution "B"). The remaining part of the installation consists of a pump, pipe lines and devices for mixing the solutions and applying the foam to the fire. In case of fire, the two foam chemical solutions are pumped separately in equal volumes through a twin system of pipe lines to specially designed mixing chambers mounted on the oil tanks, or to portable devices which are provided for emergencies.

The two foam chemical solutions "A" and "B" are made up in the following proportions:

Solutoin "A"—

	Percentage by Weight	Contents of One Gallon of Solution
Aluminum sulphate	...13%	1.163 lbs.
Water	.....87%	0.935 gals
Solution "B"—		
Sodium bicarbonate	.. 8%	0.708 lbs.
Liquid foaming extract	3%	0.265 lbs.
Water	.....89%	0.946 gals

When these two solutions are mixed, the following chemical reaction takes place: 6 Na H CO_3+$Al_2(SO_4)3$=3 Na_2SO_4+6 CO_2+2 Al $(OH)_3$. It will be noted that the liquid foaming extract plays no part in the chemical reaction. When the sodium bicarbonate and aluminum sulphate combine, there is a rapid effervescense of the mixed liquids resulting from the formation of the carbon dioxide gas. Simultaneously, the formation of gelatinous aluminum hydrate reduces the surface tension of the liquid to the point that bubbles are quickly formed. The presence of the foam stablizer makes these bubbles extremely tough, durable and tenacious. The two solutions are of such concentration that when equal quantites of each are mixed, they produce approximately eight to ten times their combined volume in foam. This foam has the property of floating on liquid surfaces, adhering to walls, ceilings, etc., and in fact coating any surface which can burn. Once such a surface is so coated, the fire is effectively extinguished and cannot reignite until the foam breaks down, which it does very slowly.

Actual tank fires have demonstrated that from one to two gallons of each chemical solution are required per square foot of burning oil surface before the fire is extinguished. It is customary to provide a factor of safety in the amount of chemicals which are carried on hand in liquid storage, as it is practically impossible to mix the dry chemicals rapidly enough during a fire to replenish the supply. Obviously, the several factors are as follows:

1. The area of the largest tank.
2. The area of other tanks in the immediate vicinity of the largest.
3. The total number of tanks to be protected.
4. Allowances for favorable conditions such as incombustible roof, oil of low volatility, etc.

These factors have been combined in the following empirical formula:

$S=(5A+3B+2C+D) \times (1+0.02(N-5) \times (1-R)$ where

S=Volume (U. S. Gals.) of each chemical solution to be provided.

A=Area (sq. ft.) of oil surface of the tank having the largest exposed area*.

B=Area (sq. ft.) of oil surface of all tanks (not including oil tank "A") within the exposed area * of tank "A" and lying wholly or partially within a distance of one tank diameter ** from tank "A".

C=Area (sq. ft.) of oil surface of all tanks (not including oil tanks "A", "B" and "C") within the exposed area * of oil tank "A" and lying wholly or partially within a distance of two tank diameters ** from oil tank "A".

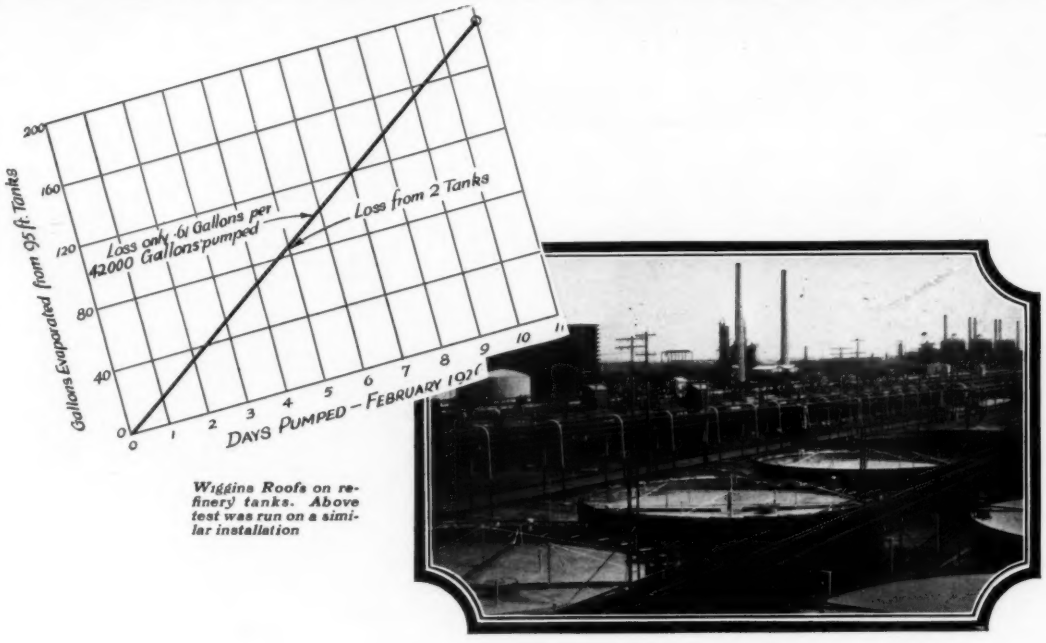
N= Ratio of total oil surface area of all protected tanks on premises to oil surface area of oil tank A.

R—Reduction in solution quantity depending upon conditions favorable to fire extinguishment such as low volatility of oil, incombustible roof members, etc.=0 to 50 per cent. ***

*Exposed area is the area represented by that quadrant of a circle (whose center is the center of that tank and whose radius is equal to 3½ times the diameter of that tank) which yields the largest amount of solutions when calculated in accordance with the foregoing formula.

**Distance expressed in diameter of oil tank "A" and measured from shell (not center) of oil tank "A".

***For such tanks as have roofs of all-steel construction and/or contain high flash point oils "Fuel, lubricating or gas oil, wax, paraffin, tar, etc.) on properties, the nature of which assures that the class of the tank contents will remain unchanged, reduce the factors by 0 to 50 per cent, according to conditions, i.e., to the proportion of the aggregate area of tanks with roofs of all-steel construction or high flash point oils to the total area of all tanks. Where all tanks contain oil of low volatility, the maximum credit is 20 %. Where all tanks are of



Wiggins Roofs on refinery tanks. Above test was run on a similar installation

Only 195 gallons evaporation loss in eleven days

The test charted above was conducted by a large refining company to determine the actual evaporation loss from working tanks equipped with Wiggins Roofs. It shows that the loss from two 95-foot diameter tanks during 11 days was only 195 gallons.

The tanks were connected through a pump and their contents pumped back and forth at a rate of 29,100 barrels per day. Approximately 320,000 barrels were handled during the 11 day test period.

The oil used was extremely volatile, having an evaporation tendency (vapor pressure) about twice that of motor gasoline. The engineers working on the test had complete information on evaporation losses from working tanks of standard construction. They estimated that the loss would have been 20,000 gallons had this operation taken place on gastight tanks. The Wiggins Roof loss was less than one per cent of that amount.

Wiggins Roofs can be installed in your present tanks as well as in new tanks. Give us the diameter and location of several of your tanks. We will be glad to quote you our price on equipping them with Wiggins Roofs.

CHICAGO BRIDGE & IRON WORKS

Dallas, 1655 Praetorian Bldg.
San Francisco, 1051 Rialto Bldg.
Cleveland, 2254 Union Trust Bldg.
Chicago, 2463 Old Colony Bldg.
New York, 3102 Hudson Terminal Bldg.
Atlanta, 1046 Healey Bldg.

WIGGINS ROOF

all-steel construction, the maximum credit is 30 per cent.

Solution "A" is good until used unless it becomes contaminated with oil. Solution "B" is subject to slow deterioration. The sodium bicarbonate in aqueous solution will gradually revert to normal carbonate as follows:

$2\ Na\ HCO_3 \rightarrow Na_2\ CO_3 + H_2O + CO_2$.

Loss of CO_2 reduces the volume of foam which the solutions should normally produce. Frequently, the fire extinguishing quality of the foam is likewise affected. When the loss in volume approximates 25 per cent, it is customary to consider the "B" solution to be in unsatisfactory condition, and steps are then taken to "revivify" it.

Number of Tanks

Fortunately, the above chemical reaction is reversible, and by adding an excess of CO_2 gas to the "B" solution under pressure, it is possible to retsore the original efficiency at about one-tenth the cost of renewing the solution.

Occasionally the solutions become contaminated with traces of oil, and the quality of the foam is seriously affected. Under such circumstances, the solutions have to be renewed as no effective way of completely removing the oil has been devised.

It is customary to provide either two or four foam solution tanks at each installation. It is safer to have the solution stored in four tanks than in two, as repairs to one tank, renewals of solutions, etc., can be effected without putting the entire system out of commission. Tanks for the "A" solution should be lined with lead, as this solution readily attacks iron and steel.

When such an installation is erected in climates where freezing temperatures are encountered, they should be housed, or encased with tile jackets. If the latter method is followed the jackets should be spaced sufficiently far from the tank shells to permit of the installation of steam coils in the annular space surrounding the tanks. Heating facilities in the housing or jacket should be sufficient to keep the temperature of the solutions above 60 degrees F. Heating coils installed within the tanks and in contact with the liquids are unsatisfactory, particularly in the "A" solution. It will be found that coils so installed give continual trouble.

Where large amounts of foam solutions are stored, it is customary to install a relatively small dissolving tank. The solutions can then be prepared in the small tank in batches and pumped into the large storage tanks.

The dissolving tank is usually sunk into the ground with its top just above grade. A grating is placed over it, so that barrels and drums containing the chemicals may be rolled thereon and emptied into the tank. Depending upon the size of the installation, the dissolving tank normally ranges in size from 500 to 2,000 gallons capacity.

Positive displacement pumps, preferably of the piston type, are generally selected. The pistons handling each solution, having equal displacement and operating at the same speed, displace equal volumes, thus metering equal amounts of chemicals and producing the best foam. Such pumps are usually steam driven, but power pumps, driven by a prime mover are frequently employed. The capacity of the pump should be such that it will deliver 1/20 of a gallon per minute of each of the two foam solutions for every square foot of area on the largest risk, vis., the area of the largest individual oil tank protected.

Steam driven pumps of the twin, duplex type are most frequently employed. It is important that the valves and ports of the pumps be large so that when operating at rated capacity, the fluid velocity through them shall not exceed 200 feet per minute. Both ends should be fully bronze fitted.

The pump selected should be capable of developing a pressure when operating at its rated speed, which will deliver the required quantity of solutions to any part of the plant.

Pipe Specifications

Tables No. I and II supply data on friction losses so that the designer can determine the size of pipe lines required, after having first determined the quantity of each solution which must be provided for each risk to be protected.

In general, standard weight, wrought steel pipe and cast iron fittings are employed throughout, except that steel, or malleable iron fittings, are used in the vicinity of tanks or other risks wherein the severe stresses of explosions may be encountered, or, where the heating and cooling effect of alternate application of fire and water may be experienced. Rising stem, gate valves are employed and are therefore self-indicating. Where valves are normally in contact with the "A" solution, a specially designed acid resisting valve is used, otherwise brass, or iron body,—brass fitted valves are used.

All pipe lines inside fire walls and near tanks should be laid at least six inches below ground. All underground pipe should be protected from corrosion by the application of hot asphalt or other bituminous preparation prior to placing the pipe. All valves should be located by conspicuous markers. Drains should be provided at low points in all field lines.

Control valves should be located outside of fire walls and not less than a tank's diameter away from the tank they control. In no case should such control valves be located nearer than 50 feet to the tank protected.

Suction lines for each chemical solution should be protected from freezing by being placed in underground conduit or pipe trenches through which a steam heating line passes.

In general, the connections at the pumps should be so arranged, first, that the solutions may be drawn from the solution tanks and discharged into the field lines; second, that the suction and discharge connections on the pumps can be reversed so as to suck from the field lines and return the solutions therein to the tanks; third, fresh water connections should be made to the pump suctions, these connections being independent of the suction lines for the chemical solutions; fourth, the pump suctions should have connections to the dissolving tank so that the freshly mixed chemical solutions may be withdrawn therefrom and discharged into the solution tanks.

In order that the foam solutions may be effectively applied to a burning tank, it is desirable, first, to produce the foam as near the fire as possible; second, to have the chemical recation completed before the foam reaches the fire, and, third, to subject the foam to as little rough usage as possible.

So-called mixing chambers are manufactured for this purpose and are devices that are adapted for permanent installations on vertical oil tanks, so that the foam may be generated in them and discharged into the tanks over the top of the shell through an opening in the roof. It is important that the connection between the mixing chamber and the tank shell be very secure, but the connection to the tank roof must be very fragile (but gastight) so that if the roof is damaged by an explosion, the mixing chamber will be unharmed. Also, it is advisable for tanks containing volatile oils to have the mouth of the mixing chamber sealed so that the vapors will not condense in the mixing chambers and run back into the pipe lines.

In selecting mixing chambers for any tank, it is desirable to secure the manufacturer's recommendations, both as to size and type of mixing chamber to be employed.

No foam installation is complete unless foam hydrants are provided and available for use at all locations where oil fires may occur. In general, they should be located not nearer than fifty feet and not further away than 250 feet from the risk which they are to protect.

Hose reels should be provided and located at strategic points around the plant. These portable reels should be equipped with twin lengths of rubber covered, rubber lined linen hose. The working length of hose on the reels usually varies from 100 to 300 feet, according to the spacing of the hydrants in the risk protected. The reels are housed in buildings designed for that purpose and carry suitable mixing nozzles, spanner wrenches, gaskets, hydrant wrenches, etc.

In certain instances, especially in congested refineries, it may be advisable to have the hose coupled to the hydrant and stored in specially prepared hose racks.

Hose Specifications

The standard size of hose adopted for foam systems is 1½-inch, rubber covered, rubber lined. However, in large refineries, where there is a sufficient crew to handle heavier hose, 2½-inch hose is frequently used. These lines are simesed together into a 3½-inch mixing tube connected to a suitable play pipe. In general not less than 30 pounds pressure and preferably 60 pounds should be available at the nozzle.

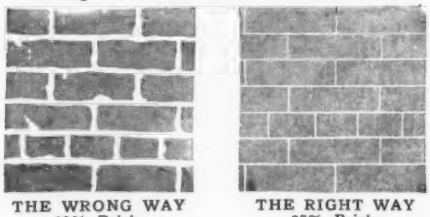
It is customary to assume that the 1½-inch line will discharge 75 gallons per

QUIGLEY PRODUCTS
For the Oil Industry

HYTEMPITE:

The standard for comparison in high temperature cements. It sets at normal temperatures and retains its strength up to temperatures at which the best fire brick loses strength and becomes soft.

Compare these Fire Brick Walls



THE WRONG WAY
89% Brick,
11% Fire Clay Joint

THE RIGHT WAY
97% Brick,
3% Hytempite Joint

Used for furnace and boiler settings and repairs; for setting tile, retorts, oil stills, lining metal melting furnaces, pit furnaces, foundry cupolas and ladles and for patching hot furnaces.

400 pounds of Hytempite will lay 1000 brick—this factor should be considered in figuring cost of fire brick work.

Ask for copy of "Hytempite in the Power Plant."

QUIGLEY GAS-TITE BAFFLES

Gastite Baffles bonded with HYTEMPITE stand up under forced firing, cling close to the tubes and don't develop cracks due to extreme temperature variations.

Four years ago a prominent contracting company installed a Gastite Baffle in a Power Plant at Jersey City, using a mixture of HYTEMPITE and Crushed Old Fire Brick. Since then 70% of the tubes have been removed and replaced without damage to the baffle. Details fully described in *Booklet H109R.*

Baffles are also being repaired and built with the Quigley Refractory Gun (described in next column).

GANISAND:

A highly refractory fire sand used for furnace linings, special shapes and tile, boiler baffles, and for patching work in furnaces, boiler settings, etc.

Hytempite is used as a binder. Shipped in 125-pound bags.

Booklet G116.

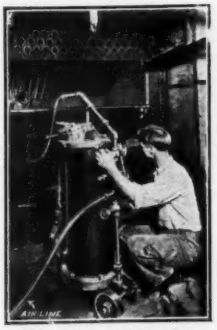
Patching Boiler Settings with Hytempite

QUIGLEY REFRACTORY GUN:

This gun handles pre-mixed refractories or other materials. It shoots the plastic mixture with high velocity at any place in wall or arch. The mixture will stick to a hot or cold wall, owing to force of application, in cases where troweled or rammed-in application might fail to hold. You can

- Fills Cracks or Holes
- Restore a Burned Out Wall
- Fill Gaps in Walls or Arches
- Re-surface Old Walls
- Repair Leaky Baffles
- Build New Baffles
- Surface New Walls

And in many cases you can make repairs while the furnace is hot.



Repairing Baffle with Quigley Refractory Gun

A whole battery of furnaces can be repaired in the time formerly required to repair one.

Used by many large Industrial Plants and Public Utilities. Details are described in *Booklet RG130.*

PROTECT YOUR PLANT & EQUIPMENT WITH QUIGLEY TRIPLE-A SOLUTIONS:

They meet the demand for real protection under most severe conditions. They are not "just paints." They combine the three essentials for a permanent protective coating for iron, steel, galvanized and plated surfaces, concrete, stone, brick, cork insulation, etc. They are alkali and waterproof and resist the action of acids.

TRIPLE-A has a background of many years' successful use among Public Utilities and Industrial Plants, Waterworks, Chemical, Refrigerating, Marine and Railway fields.

TRIPLE-A Solutions are used on

Structural Steel	Dry Kilns
Steel Stacks	Ducts and Fans
Ventilators	Industrial Machinery
Skylights	Bridges
Cooling Towers	Framing and Sash
Backstays and Chimney Bends	Metal Roofs
Tanks	Iron Fences
Pipe Lines	Transmission Towers
Sprinkler Systems	Buildings
Boiler Fronts	Cranes
Breechings	Etc., Etc.

and any machinery and equipment to prevent corrosion.

QUIGLEY ACID PROOF CEMENT:

A carefully compounded ready-to-use cement for acid proof construction. A mortar and protective coating. It resists strong, weak or mixed solutions of sulphuric, nitric, hydrochloric, phosphoric and other corrosive acids and gases. Used for stack construction, etc. *Booklet A117.*

Quigley SERVICE is rendered by our distributors, with warehouse stock, located in every oil center in the United States, Canada and at many foreign points.

QUIGLEY FURNACE SPECIALTIES CO., Inc.
26 Cortlandt Street, NEW YORK, N. Y.

minute of each solution whereas the 2½ inch line will discharge about 250 gallons per minute of each solution. The mixing nozzle sets referred to in the foregoing are of standard design and comprise the following equipment:

1½-inch units—1 nozzle, 2½x30-inch; 1 nozzle top, 1⅛-inch smooth bore; 1 mixing tube, 2½-inch x 5-foot; 1 Siamese connection, 1½x1½x2½-inch.

2½-inch units.—1 nozzle, 3½x14-inch; 1 nozzle tip, 1¾-inch smooth bore; 1 mixing tube 3½-inch x 8-foot; 1 Siamese connection, 2½x2½x3½-inch.

All threads on nozzles, mixing tubes and Siamese are straight iron pipe hose threads.

There are many special applications of foam protection that have not been given space in this paper. The design of adequate foam protection for special risks is a subject in itself, however, the following are the principal items to be considered.

1. A more than adequate supply of foam solutions.

2. Pipes and delivery facilities large enough to put properly mixed foam on the fire rapidly.

3. Mechanical perfection of design of all parts—especially those handling the "A" solution.

4. Adherence to tried methods and apparatus.

5. Facilities for inspection and testing. Don't forget that the equipment may stand idle for years before it is called into service.

In conclusion, the fire record of the oil business is remarkably good considering the nature of the products handled, their volume and the far reaching extent of the industry. Oil fires seldom occur but when they do they may be readily segregated, controlled and extinguished when good design and adequate fire equipment are employed.

Announce Change in Directorate and Refining Department of Standard of Indiana

Chicago.—Important changes in the directorate and heads of the manufacturing department of the Standard Oil Company, (Indiana) have been announced.

William E. Warwick, who has completed 38 years of service with the company, tendered his resignation as vice-president, director and general manager of the manufacturing department, effective January 1, 1927. He will be succeeded on the board of directors by Dr. R. E. Humphreys, manager of the Whiting refinery, who also becomes assistant general manager of the manufacturing department.

Beaumont Parks, vice-president and member of the board and assistant general manager of the manufacturing department, succeeds Mr. Warwick as general manager of that department.

Colonel Stewart, in making announcement of Mr. Warwick's resignation said:

"Mr. Warwick's services with this company have been untiring, faithful, and loyal. He has occupied many positions of trust in the manufacturing department of the company, and for the past seven years has been a director. It is with the sincerest regret that the board of directors has accepted his resignation.

Mr. Warwick has been invited to act as advisor in refinery matters to the chief executive and board of directors of the Pan American Petroleum & Transport Company, which invitation he has accepted."

Mr. Warwick began service with the company 38 years ago as a draftsman after completing his college course at Ames College, Iowa. Subsequently he was made assistant master mechanic and superintendent of the paraffin department, and later superintendent at Whiting. While living at Whiting he was elected mayor for two terms, serving from 1903 to 1907.

Dr. Humphreys has been with the company 26 years. He started work in the laboratories at Whiting as a chemist, later was made assistant superintendent and subsequently manager of the refinery.

Other changes and transfers at the Whiting refinery effective January 1, 1927, were also announced.

Dr. Gentry Cash, superintendent of the Whiting refinery succeeds Dr. R. E. Humphreys as manager.

H. F. Glair, assistant superintendent becomes general superintendent of the refinery.

J. E. Evans, assistant superintendent is appointed to the position of assistant general superintendent.

Dr. O. E. Bransky, superintendent of the paraffin department becomes assistant general superintendent.

Dr. E. J. Shaeffer, superintendent of the light oils department becomes assistant general superintendent.

F. D. Rexwinkle, assistant superintendent of the paraffin department becomes superintendent of that department.

P. J. Sweeney, foreman in charge of pressure still operations becomes superintendent of the light oils department.

Dr. A. S. Musselman, foreman in charge of treating in the paraffin department is appointed assistant superintendent of the paraffin department.

TABLE I

Friction Loss in Feet Head Per Foot of Pipe

Diameter of Pipe	Required Gallons Per Minute											
	1	3	5	7½	10	15	20	25	30	40	50	75
½	0.02	0.16	0.41	0.87	1.47							
¾		0.04	0.11	0.22	0.38	0.8	1.36					
1			0.03	0.07	0.12	0.25	0.42	0.64	0.89	1.52		
1¼				0.02	0.03	0.06	0.11	0.17	0.24	0.40	0.60	1.29
1½					0.01	0.03	0.05	0.08	0.11	0.19	0.28	0.60
2						0.01	0.02	0.03	0.04	0.07	0.10	0.21
2½									0.01	0.02	0.03	0.07
3										0.01	0.02	0.03

TABLE II

Diameter of Pipe	Required Gallons Per Minute Friction Loss in Feet Head Per Foot of Pipe												
	100	150	200	250	300	350	400	450	500	550	600	800	1000
1½	1.02												
2	0.36	0.76	1.29										
2½	0.12	0.26	0.43	0.65	0.92	1.22	1.56						
3	0.05	0.11	0.18	0.27	0.38	0.50	0.65	0.80	0.98	1.17	1.37		
4	0.01	0.03	0.04	0.07	0.09	0.12	0.16	0.20	0.24	0.29	0.34	0.57	0.88
6				0.01	0.014	0.018	0.022	0.027	0.034	0.04	0.05	0.08	0.12
8										0.01	0.012	0.02	0.03
10													0.01

Rubshell Paint Protects Tank Covers

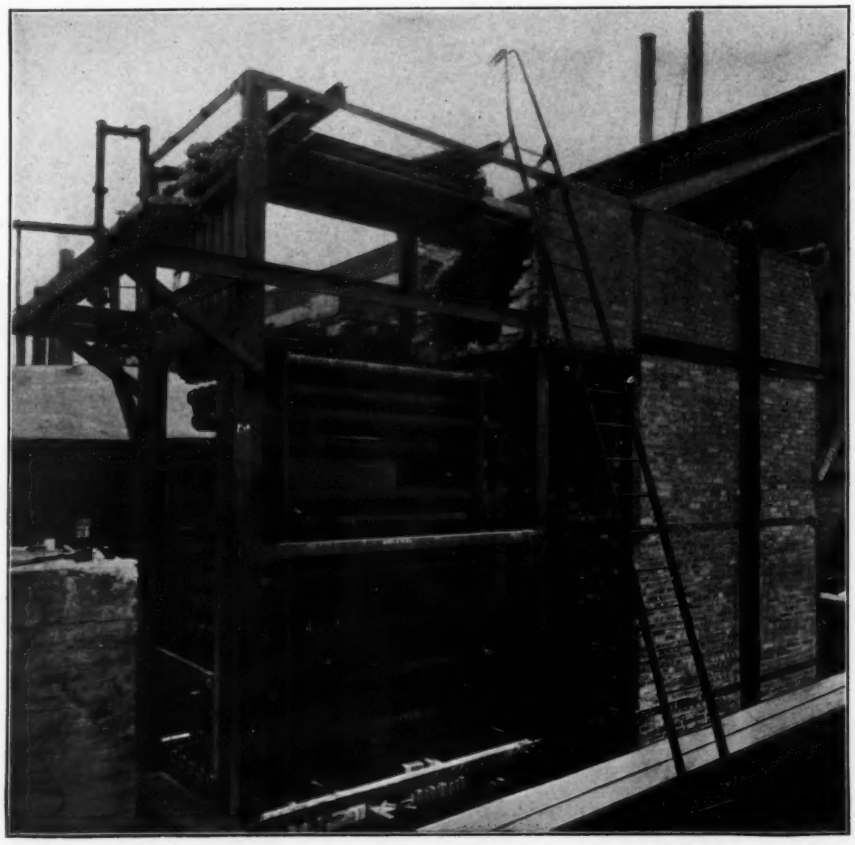
Rubshell is the name of an acid-proof paint developed by the International Compositions Company, Inc., 25 Broadway, New York City, and being distributed through various representatives. The J. A. Rossiter Company, Union National Bank Building, Houston, Texas, is the Texas distributor.

Numerous experiments have shown Rubshell to be successful in preventing corrosion on the under side of tank covers, treating agitators, and condenser boxes, according to the manufacturers, and tests have also shown that it holds up well in salt water. Atmospheric conditions along the seashore are said not to affect the efficiency of the paint.

More information will be provided by the manufacturing concern or by the distributor.

FOSTER

TUBE STILLS



Foster Tube Stills burn the fuel completely, absorb efficiently the heat generated, and prevent overheating the oil or the heating surface. The design of Foster Tube Stills is based on a quarter century of experience in solving heat transfer problems of every nature, and more than 500 highly successful refinery installations testify to Foster efficiency and reliability.

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Branch Offices in All Oil Centers

Paraffine Wax—Its Properties and Separation

By ISMAR GINSBERG

PARAFFINE wax is a very important commercial product. It is one of the most valuable products that are obtained from the distillation and refining of petroleum oils. Its importance however does not rest solely on the use to which it is put in industry but it is also a very important substance from the standpoint of the lubricating oil refiner. For in this country at least three quarters of all the lubricating oil used is made from petroleum oils of a paraffine base. In refining the oils, it is found that the boiling range of the wax is quite similar to that of the lubricating oil itself, and the result is that it is a very difficult matter to separate the wax from the lubricating oil. That it is necessary to do so needs no comment, and so the problem is one that must be satisfactorily solved in each refinery before a lubricating oil of the proper qualities can be produced.

Thus it is easy to see that paraffine wax is a very important product to the oil refiner, both because it yields some return on sale and because it gives him a great deal of trouble in separation from the lubricating oil, so much trouble indeed that some refiners claim that the expense of removing the wax does not begin to be compensated by the returns obtained through its sale.

Nevertheless paraffine wax is an important and interesting product and a study of its properties will be of advantage and may possibly yield information that can be utilized in its removal from lubricating oils. Paraffine wax in the pure condition is a colorless, odorless and tastless substance when in the molten state. When cooled below its melting point it becomes translucent and is apparently an amorphous substance. The melting point of this substance is between 115 and 150 degrees F although it has been reported that paraffine waxes obtained from certain petroleum (found in Pennsylvania) have melting points as high as 170 degrees F. The snowy white appearance of the solid wax is due to the admixture of air with it.

Recent Studies

Some very interesting studies have been made on the physical and chemical properties of paraffine wax and were recently reported in considerable detail in the Journal of the Institute of Petroleum Technologists. This work was divided into seven parts. Burmah waxes were used for example in the determination of molecular weight and melting point. These waxes were crystallized form various solvents, such as petroleum spirit, chloroform, benzol, carbon disulphide, etc. The ebulliscope method was employed in the determination of the molecular weights. The results showed that practically all of the hydrocarbons from $C_{21}H_{44}$ up to $C_{84}H_{170}$ are present in this paraffine wax. Various fractions were also obtained and analyzed. The results are given in tabular form in the original article and form very valuable data on these properties of paraffine wax.

A study was also made of a very high melting point wax. Waxes having melting points of 84 to 85 degrees C were found. Such waxes were found to be insoluble in solvents. The hydrocarbon in the wax with the highest number of carbon atoms appeared to be $C_{57}H_{116}$.

A third section of this general investigation dealt with the cooling, expansion and microscopic properties of waxes in the mass. Thus by melting the wax in a watch-glass and allowing it to cool it was observed that when the wax set initially needle like formations were visible at the edges of the liquid, then after initial plasticity the mass became opaque over a range of 5 to 10 degrees C below the melting point with a dull surface. The mass then became translucent again and this happened from 10 to 15 degrees C below the melting point. The surface became shiny and the crystals evidently packed up considerably. Small flowery patches of air separated at the crystal edge. On reheating air bubbles were expelled. Under the microscope it was observed that when pure wax cools slowly away from the liquid state, it appears first to yield needles. Then if the mother liquor is poured off from the partially solidified mass, this becomes very evident.

Tests were also made on the crystallization of the wax from solvents and from mineral oils as well. The latter is of great importance to the refiner. Some very interesting observations were made and conclusions reached of which the following is a resume.

Cooling and Crystals

In the first place it was found that the more rapid the rate of the cooling of a given heavy oil wax distillate mixture between certain ranges the smaller the crystals obtained. Then again the crystals are the smaller, the more concentrated the solution of wax. It is suggested that this may be compensated for by the slower cooling of the mixture which is brought about by the evolution of more latent heat. Furthermore another factor influencing the size of the crystals is the viscosity of the mother liquor, and the more viscuous this liquor the smaller the crystals. The conclusion that was reached in this series of investigations by Carpenter is that if a good wax is to be obtained from a high distillate fraction, it may be necessary to cut back the fraction with a light oil before cooling and pressing.

The importance of the manner in which the wax cools and the size of the crystals that are formed is evident when it is brought to mind that the ease and effectiveness with which the wax separates from the oily mixture is dependent on this to a very large degree. Thus it has been found that the wax in one crystalline form will separate itself more readily from the oil than in another form. To obtain the wax in the proper crystalline state is thus a function of the refiner who desires to make a first grade product.

The compactness of the crystals is also a consideration. Thus it has been observed that when the wax is crystallized out in needle shaped crystals, these do not lie very compactly, or rather more loosely in an open network than the foliaceous masses of wax. Hence when the wax is pressed to free it from oil, it is found that the oil runs out very readily. One difficult point is to arrive at an accurate conception of the effect that is actually produced by the fine crystals. What is meant is that the aid that is afforded by the formation of fine crystals in the wax in the subsequent pressing operation is hard to measure but it is generally agreed that an appreciable influence is exerted.

Another method of cooling which gives good results is the one that is carried out in stages, that is slowly at first and then rapidly afterwards. The two stage cooling process yields crystals of paraffin wax which are in good condition and which also lie loosely packed so that it is a comparatively easy matter to press the oil out of them. There are also certain advantages connected with slow cooling of the mixture of oil and wax at a high temperature to begin with. The high temperature makes the oil less viscous which allows the crystals to be formed in good condition which cannot take place when the oil becomes more viscous due to the lowering of the temperature. This is an important point

(Continued on Page 78.)

During

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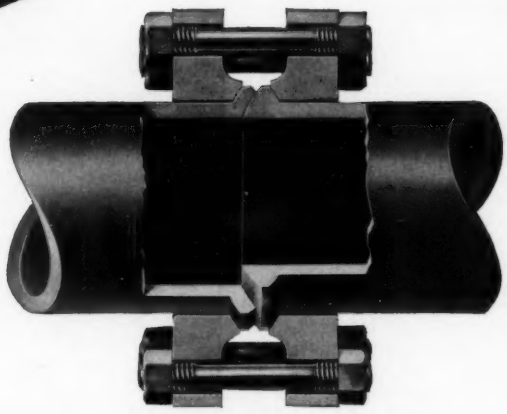

were installed by Refiners

VERY good reasons must exist for such wide acceptance and use of Midwest Joints among the refiners of the country. And present indications are that the number of Midwest Joints placed in refinery service during the last half of this year will far exceed the figure for the first six months.

Midwest Joints are used principally upon piping for cracking units operating at pressures from 200 to 500 pounds and with temperatures ranging from 700° to 1000° Fahrenheit. Refiners are now also using them on hot oil lines regardless of pressure—wherever there is danger of a leak, flash and fire. Another important application is upon high pressure steam lines.

Midwest Joints require no gaskets—there is nothing to blow out and cause a flash and fire with its frequent expensive and disastrous consequences.

Erection of piping is greatly simplified when it is provided with Midwest Joints—because their contact surfaces are spherical and the piping need not be in perfect alignment. Deflections to 3° are possible.

These are simply a few of the many advantages that Midwest Joints have for the Refiner. We shall be glad to send you complete information and performance data without obligation.

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Fabricators of Oil Refinery, Natural Gasoline Plant and Power Piping

MIDWEST Joints and Piping

Safety and Speed on Richfield Loading Rack

By GEORGE REID
Staff Representative

THE loading rack at the Richfield Oil Company's Hynes, California refinery is a thing of grace and beauty and constructed after the design of company engineers embracing the three important factors of permanence, convenience and safety.

In the design of the loading rack the company has departed from the somewhat extensive practice of construction involving the use of used pipe and the welding torch, and built thier rack of structural steel throughout. The structural steel construction was done by the Western Pipe and Steel Company, following the design and specifications of the Richfield Company engineering department. The rack is 1320 feet long, which provides space for spotting 32 cars on each of the double tracks. Estimates of both methods of construction, pipe or structural steel, indicated that the latter method was but little more costly than the welded pipe rack. With the advantages of strength and durability, as well as the better appearance of the job when completed, the additional cost was not considered as important. The results of such a policy are indicated in the symmetry of design, the appearance of grace in the construction, and the sturdiness of the steel braced structure. With loading lines suspended overhead, and with cars loading various different sections, the rack is almost vibrationless.

Ease of Operation

The type and size of the steel supporting structure employed in the construction of the loading rack is shown in accompanying illustrations.

Figure 1 illustrates the construction in some detail. The steel supporting structure carries the series of loading lines at the top, at about six feet above the board walkway. Note in the foreground the swing device which makes for ease of handling the loading spout. This view shows that portion of the rack given over to the loading of fuel oil and heavier distillates. The swinging loading spouts are very easy to handle. The section of flexible loading hose at the end of the spout makes easy the insertion of the spout into the dome or manhole of the car.

The walkway is provided with a continuous length of steel cable instead of the usual bulky pipe rails, as a safety measure. The guide rails, or cables, become important adjuncts in rainy weather, such as was prevalent at the time the accompanying photographs ware taken.

Bridges Safe

One of the most important devices embraced in the design and construction of the loading rack is the counter balance "bridge" which leads from the board walk to the tank car at each car spot or set of loading spouts. This swinging bridge is one of the newer devices indicated in loading rack design for which the loader or rackman may be truly thankful.

The old method of supplying large boards, which, when not in use tend to clutter up the top of the rack in such a manner that they present an actual hazard to the life and limb of the employee, is eliminated. When the boards are used to bridge the gap between rack and tank car they then constitute an even more hazardous contrivance. The counterbalanced permanent bridge type as employed on the Richfield rack is a safety measure of importance and is also conducive to making easy the rack work. As an item of convenience and safety they can hardly be overstressed, for the construction of the swinging bridge makes unnecessary the removal or swinging-up of them in the event of a "switch." The detail of construction of these safety "gang planks", are shown in Figures 2 and 3. Note that the swing-joint, where the hinges are placed, extends outward from the rack proper far enough that when the small platform is raised upwards and completely out of the way, the vertical safety posts do not extend into the walkway or working space upon the rack platform. In Figure 2 the "bridge" is shown raised in its place when not in use. The two chains which act as guard rails can be seen, slack. When the bridge is down and in use, as in Figure 3, the chains are taut across the top of the "bridge." The counter balancing weight is shown extending downward when the bridge is out of use—Figure 2. These bridges are easily handled, and the slightest tug or push will either raise or lower them into the desired position.

In addition to the features enumerated above, the bridges are conveniently designed so that the length, when the bridge is down and in use, is not sufficient to interfere with the movement of the tanks cars at switching time, but the rack can be pulled at any time regardless

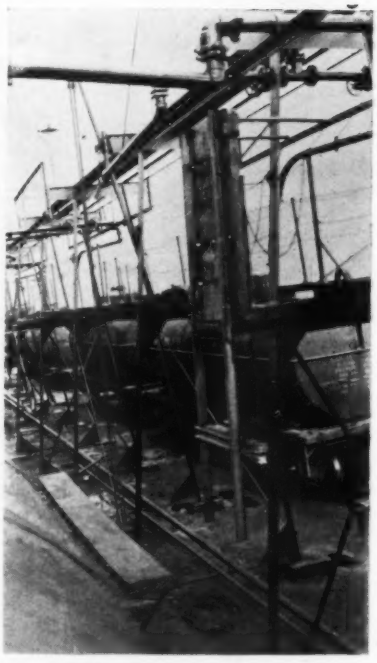


Figure 2.—Showing the swinging, counter balanced bridge in position when not in use.

Figure 1.—Showing construction details of the structural steel loading rack at Richfield Oil Company's Hynes, California, Refinery.

A heat exchanger and condenser in one

Note the multiple shells of the G-R Sectional Condenser

With two sections, water can be used as the cooling medium in one unit and oil in another, thus providing a condenser and heat exchanger in one set.

Furthermore, a different "cut" or "fractionation" can be made in each section by offsetting the lower vapor connection to the side of the shell and draining the distillate from the sump thus formed in the vapor space.

And note, too, the many operating advantages of this arrangement. Sections can be added or removed to meet varying capacity requirements. The complete unit is readily transported and assembled if necessary to meet changing plant conditions. Inspection and cleaning is greatly facilitated.

Send the Coupon for Complete Information

THE GRISCOM-RUSSELL COMPANY
285 Madison Avenue

Philadelphia	Chicago	St. Louis	San Francisco
Boston	Cleveland	Kansas City	Los Angeles
Rochester	Detroit	Charlotte	Seattle
Pittsburgh	Milwaukee	New Orleans	Denver
Columbus	Minneapolis	Houston	Salt Lake City
Atlanta	Indianapolis	Dallas	Tulsa

For Canada: Riley Engineering and Supply Co., Ltd., Toronto

Griscom-Russell
Heat Transfer Apparatus

Note these other G-R Units for lower repairing costs

Mineral Seal Oil Heat Exchangers

A compact, twin exchanger with strict counter-current flow to promote maximum rate of heat interchange.

G-R Vaneflo Gas Cooler

for cooling casing head of natural gas. Can be used as inter-, after-, or precooler in absorption and compression type natural gasoline plants. Has low pressure loss and exceptional efficiency.

G-R Jacket Water Cooler

uses any source of raw water to cool the jacket water from oil and gas engines and compressor. The famous Multiwhirl Cooler—over 2000 in operation in every liquid cooling service.

G-R Gasoline Condenser

for condensing natural gasoline vapors in casinghead gasoline plants. Can also be used as a knockout box or fractionating tower control section with particularly close control of the end points.

G-R Twin Heat Exchanger

for the efficient interchange of heat between crude oil feed stock and still bottoms, cold water and hot oil, feed stock and hot still vapors, etc.

The Griscom-Russell Company.
Dept. K, 285 Madison Ave.,
New York.

Please send information on

- ☐ Sectional Condenser
- ☐ Mineral Seal Oil Heat Exchanger
- ☐ Vaneflo Gas Cooler
- ☐ Jacket Water Cooler
- ☐ Gasoline Condenser
- ☐ Twin Heat Exchanger

Name . .....

Address . .....

R 1-27

Mention Where You Saw the Advertisement

Figure 3.—Showing the counter-balance bridge feature extending between the rack and the tank car when in use.

of the position of the bridges. They are, however, invariably pulled upward and in the upright position when not in use, as a safety measure—assuring the closing of the guard rail along the rack top, or walkway.

Another item of interest is indicated in the design of movable metal pans which are placed over the sewer line. These pans have the overflow or drain spout situated at one end, which makes it possible to move them about by swinging them around to the needed position in the event a tank car is a little "off spot." In this way the so-called "slop" pans have a variable reach of some 10 feet, with the result that a tank car can hardly be spotted without being in reach of the sewer pan. This important item is illustrated in Fgure 4. The puddles of liquid shown are not waste oil, but water, as the pictures were taken during a rain.

Lines Separate

The loading rack is conveniently divided into sections for loading of the various products from the refinery. The products of the plant are all loaded through separate lines, which is a commendable practice, for it eliminates a number of the refinery problems in shipping. Fuel oil, still bottoms, stove oil and absorption oil are each handled through separate lines leading to certain parts of the rack, while the reminder of the loading is handled on the other portion of the rack. This consists of the various grades of gasoline and kerosene loading equpiment.

Throughout the entire rack the same idea or policy of convenience and safety is carried out. The three and four-inch loading spouts all swing easily out from the rack lines to the car, thus eliminating the lifting of heavy lengths of pipe. Beneath the rack, as shown in the various photographs, there are provided unloading lines for the usual purposes. An unloading line for natural gasoline is included in the assembly.

Because of the convenient arrangement and the case with which all working equipment can be handled the labor required to handle shipments through this rack from the 25,000 barrel refinery is very low. The sturdy, durable type of construction of structural steel is certain to assure an excellent loading rack at this plant for a very long time.

Paraffin Wax—Its Properties and Separation

(Continued from Page 74.)

and when followed out accurately in practice will do much to improve the conditions of paraffin crystallization and eliminate much of the trouble experienced with it.

Dirt Effect Trivial

Investigation has also shown that the presence of dirt in mechanical suspension, excepting when it is in the colloidal condition, has not very much effect if any on the crystallization of wax. It has also been established that asphaltic materials, resins, amorphous mineral jelly or colloidal mud all have a decided harmful action on the process, affecting both the size of the crystals and their status in the mass.

Mineral jellies are not of the same chemical composition as wax but are really lubricants containing unsaturated hydrocarbons and possessing a high flow point. These jellies, when they are converted into the liquid state, will dissolve wax and form a true solution with it, and the result then is that good crystallization is almost impossible. This is of course true only when these jellies are present in appreciable amounts.

It is therefore understandable that much difficulty will be encountered in crystallizing the wax from a product that is obtained from a mixture of asphaltic and paraffin base crude oils. In fact it is essential that the asphaltic substances are removed as early as possible in the refining process, for when they are allowed to remain in the oil up to the time that the paraffin is crystallized, they will come out of it along with the paraffin wax and then great difficulty will be enccuntered in purifying the wax by sweating and filtering. It is reported that these observations have been corroborated by many investigators.

It may be well here to describe some of the methods that have been used in determining the transition point of paraffin wax. There are in all four different methods that can be used for this purpose. Thus there are the methods that depend upon the solubility of the wax in solvents. Glacial acetic acid was used in the experiments described by Carpenter. The solubility of the wax was determined at various temperatures and decided changes were noted in the neighborhood of 50 degrees C or 122 degrees F, the melting point of the wax being 140 degrees F.

Air and Oil

The thermometric method did not give good results, for non-conductivity of the wax and the difficulty of stirring it in the solid state did not allow any determination to be made of the change in the rate of cooling or heating.

Another method was employed to determine the degree of absolute expansion as the temperature increases and also the change in density, to see if these values did not change markedly at any point. The resuits which were obtained with various grades and kinds

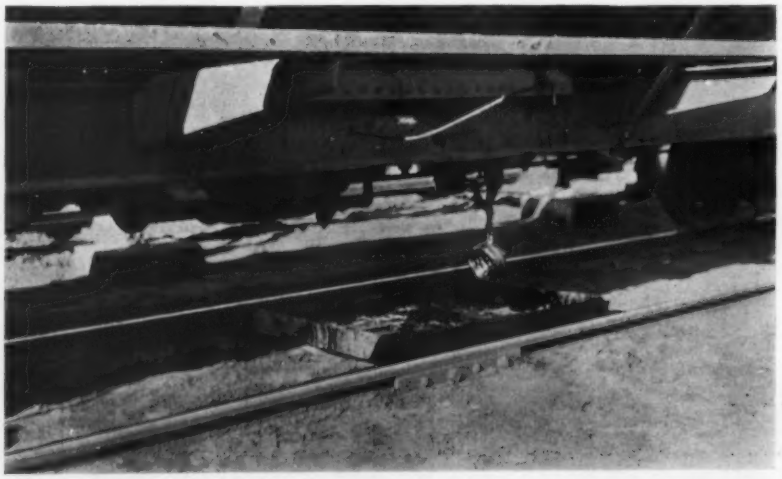


Figure 4.—Showing details of drain pan device which conducts drainings from tank cars to sewer line beneath the tracks.

STOP PIPE CORROSION
IN SMALL LINES

Our Simplex Prepared Joint Cast Iron Pipe is made in 2″, 3″, 4″ or 6″ diameters. Since it has been available thousands and thousands of feet of this material has been used in the oil fields.

Illustration of section through assembled joint of Simplex Prepared Joint Five-Foot pipe, showing asbestos endless ring gasket in place. This gasket is adapted to use for oil, vapor and acid lines. A rubber gasket is compounded to suit the particular service it is to render—steam, natural gas, artificial gas, water, oil, etc.

Its chief advantage lies in its immunity from corrosion as compared with other ferrous pipe. Its desirability is further increased by the special joint, with only two bolts, and with a thick, endless ring gasket. It is rapidly and easily laid by inexperienced men.

Wherever permanent construction is desired, it is little short of an economic crime to spend money for a pipe line of perishable material when a practically permanent construction can be obtained by the use of cast iron.

Do you know why cast iron withstands corrosion so much better than any other ferrous metal? Our Bulletin No. 44 explains it.

Simplex Prepared Joint Pipe is furnished with full line of fittings. The material is fully described and illustrated in our Catalog No. 48. Your copy is waiting to be mailed, upon receipt of your request.

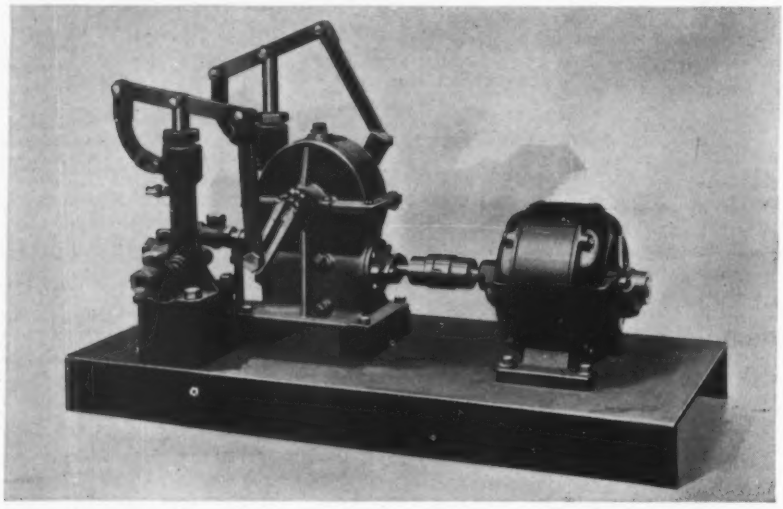
American Cast Iron Pipe Company

General Offices and Foundry: Birmingham, Ala.

Branches at
Dallas, Kansas City, San Francisco, Los Angeles, Chicago, New York, Minneapolis

Write Also for Information on Our Simplex Cast Iron Pipe for Oil Condensers

RECENT ITEMS IN PLANT EQUIPMENT



Hills-McCanna pumping device for proportioning the delivery of chemicals into process

Hills - McCanna Offer New Proportioning Pump

Hills-McCanna Company, 2025 Elston Avenue, Chicago, have recently announced a pumping device for proportioning the delivery of chemical's into process.

These pumps are the single plunger type with ball valves and packed stuffing box.

Plungers are one-inch diameter and the stroke on either pump can be regulated from zero to three and one-half inches, to give a wide range of delivery. The pumps are driven by a one-half horse power, 1725 R. P. M. motor driving through a 33-1 speed reducer, and are furnished in cast iron throughout..

They are available in various sizes, type of drives, and metals for handling various chemicals.

More specific information will be provided by the company, on request.

Crane New Heavy Steel Valves

A new series of valves of forged steel has lately been included in the list of Crane products, by the Crane Company, Crane Building, 836 S. Michigan Avenue, Chicago.

The new line of valves are noteworthy for their uniform thickness of metal. These qualities are particularly desirable to give fire-safe tightness under high pressures.

New Goetz Gasket Guide

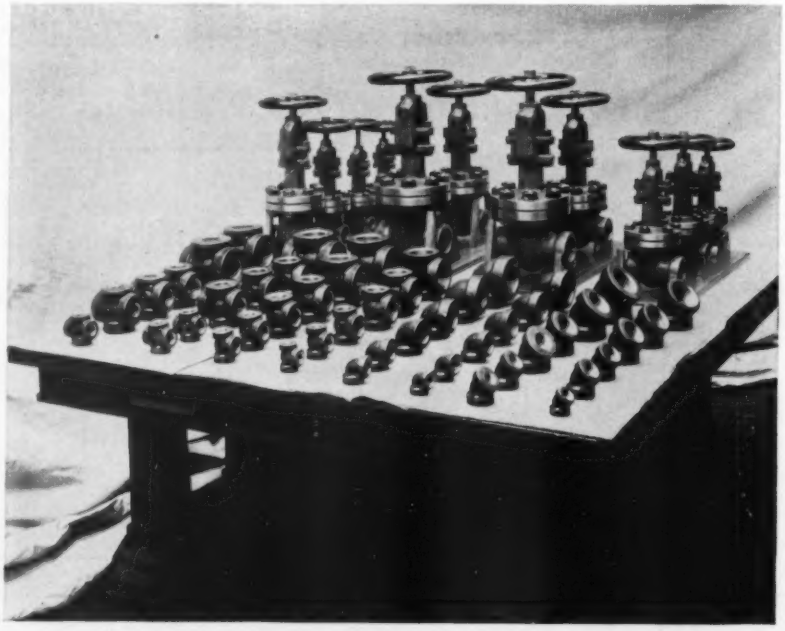
The new Goetz Gasket Guide is now ready for distribution and can be obtained from the Goetz Gasket and Packing Company, New Brunswick, New Jersey.

This publication shows some of the most successful types of metallic and metal-asbestos gaskets manufactured by this company, with other packing products. The booklet contains other valuable information to gasket users.

Tag "Codex" Catalog

The Tag "Codex" catalog of industrial thermometers, issued by the C. J. Tagliabue Manufacturing Company, 18 to 88 33rd Street, Brooklyn, New York, might be called an encyclopedia of Tag products, for it gives a minute description of every thermometer made by this company. Each item described is also well illustrated.

Considerable space is given to Tag-Hespe Glass, a special thermometer glass used by Tagliabue.



New line of valves recently announced by the Crane Company

of paraffin waxes indicated that there was a peak in the expansion some degrees below the melting point.

There are two other important factors which have a decided effect on the appearance and the properties of paraffin wax. One of these is the presence of air in the wax and the other is the presence of oil. When air is present in the wax, the candles that are made from it will be "mottled" in appearance. This is commonly known and the technologist generally advises the addition of stearin or other substances to hide this defect. The mottled appearance of the wax is even further increased by the presence of oil in the wax, and this has been held to be due not so much to the increased solubility of the air in the wax as to the internal separation of the wax crystals from one another. What holds good for air also applies to other gases such as carbon dioxide, oxygen and nitrogen.

A rather thorough study has been made of the effects of oil in wax and these have been summarized by Carpenter as follows: In the first place the oil in the wax tends to make the wax change in color, that is it becomes yellow. Wax that is free from all oil and asphaltic matters will remain perfectly free from color.

Sometime ago one of America's biggest companies installed its first Dubbs Cracking Unit

For a year it scrutinized the gasoline yields, the operating costs and compared results with those obtained from ordinary refining methods, and from ordinary cracking processes

The other day construction was ordered begun on *fifteen additional Dubbs Units* with a total cracking capacity of approximately *fifty thousand barrels daily*

The name of the company will be given on written request

Universal Oil Products Company
Owner of the Dubbs Process
310 South Michigan Ave
Chicago, Illinois

Ac-Me Company Offers New Refinery Items

The Ac-Me Company, 3235 Swiss Avenue, Dallas, Texas, has recently put on the market a number of items of interest to refiners. Descriptions follow:

Gravity Balance

The Ac-Me gravity balance is designed along the lines of the original Edwards balance, with a number of features in both design and construction that make it a practical and reliable instrument for field use as well as laboratory.

The float is five inches in diameter and eight inches long, making the instrument extremely powerful. Needle points, bearings, and knife edges are eliminated by the use of a new steel suspension. This suspension has sufficient weight, according to the manufacturers, to support 100 pounds weight, and is still sensitive to one millimeter of mercury, and is said to be accurate to one point in the third place using ordinary care.

The balance bar is rigidly locked for transportation by the turning of a lever on the outside of the balance, and it is not necessary to open the balance for transportation or to put in operation. The same lever is used to dampen the oscillations of the balance so that readings may be quickly taken either at rest or on the beat. A weight adjustment is used to adjust the center of gravity to the desired sensitivity. The float is so designed and of sufficient strength to retian its shape and volume under pressure or vacuum.

By removing wingnuts on the face of the instrument, the mechanism is easily removed as a unit.

The outside of the instrument is nickel plated to reflect external heat waves, and the inside is unpainted brass which facilitates the transfer of the heat of the instrument to the gas and air in the instrument. Thus errors due to temperature differences between the gas and air are eliminated.

The instrument is provided with two-way level, three leveling screws, and four needle valves. High pressure hoses are supplied with union connections. A manometer reading in millimeters is attached to the balance base by means of a bracket. An air dryer is supplied so that clean dry air is used as a standard. The balance is mounted on a heavy tripod, adjustable to uneven ground and locking in position. The carrying case forms a convenient seat for the operator during tests.

Look Box

The Ac-Me Lookbox is made with a specially designed lense which makes the stream visible from a greater angle than is possible with a flat glass, according to the manufacturers. The lense is held in place with a brass ring which screws into place, insuring even pressure at all points on the lense.

Light Weight Loading Dome Cover

The Ac-Me Loading Dome Cover is made of aluminum, light to handle, and fits all six- and eight-bolt dome covers. It uses a six-inch special Ac-Me lense, giving high visibility and minmum breakage.

Leak Proof Vapor Tension Bomb

The new leak proof vapor tension bomb is so designed as to give a standardized vapor tension test. The gauge is shellacked and screwed tight into the bomb. Temperatures are taken from a special armored immersion thermometer, shellacked and screwed tight into the bomb. Hand wheel caps are lead seated. According to the manufacturer, the whole bomb is lowered into a tank car, is ten per cent automatically drained out as it leaves the gasoline, caps are tightened in vapors of the dome, so that there is no chance for air to enter.

Additional information on all these items may be secured from the Ac-Me Company, 3225 Swiss Avenue, Dallas, Texas.

Conley Tank Car Co. Orders 300 Cars

Pittsburgh, Pa.—Conley Tank Car Company, with headquarters in this city, has arranged for the building of 300 new tank cars, one-half of which are to be 8000 gallons capacity, and the other half 10,000 gallons. Delivery of the cars will begin early in January, according to W. J. Curley, general manager of the company.

On the same day arrangements were completed for the building of the cars, the Conley company completed a three-year lease with a large refinery for 100 of the new cars. Mr. Curley states that his company is enjoying many inquiries and that indications are good for a big increase in business volume next year.

New Rotating Cam Limit Switch Offered

The Electric Controller & Manufacturing Company of Cleveland, Ohio, announces a new rotating cam limit switch to be used with magnetic controllers for the automatic control of machines having such fixed sequence of operation as slowing down, stopping and reversing.

This cam type limit switch is totally enclosed, is equipped with tapered roller bearings and is designed to carry up to six sets of contacts. The cams which operate the opening and closing of the contacts, are each adjusted independently of the others and can be fixed at an infinite number of positions, thus giving extreme flexibility to the machine with which it is used.

Further particulars can be obtained upon application.

"The Hydraulic Press"

The first issue of "The Hydraulic Press," a magazine which is to be published by The Hydraulic Press Manufacturing Company, Mount Gilead, Ohio, made it appearance recently.

The publication is to be devoted to hydraulic engineering and is to be issued quarterly.

The company states that it will give free subscriptions to the magazine to those interested, upon receipt of their names, addresses, and business connections.

Installing Dubbs Units at El Segundo

Chicago, Ill. — Universal Products Company, owners and licensors of the Dubbs Cracking Process used in many refineries throughout the United States, announce that the Standard Oil Company of California is to install eight Dubbs units at the El Segundo plant. Each of the units will have a daily capacity of 3000 barrels.

Standard of California already has Dubbs units in operation at the Richmond refinery, and seven others under construction.

The White Star Refining Company, Wood River, Illinois, is also putting in a third unit. This company has two units in operation now.

Portable Gasoline Plant At Nigger Creek

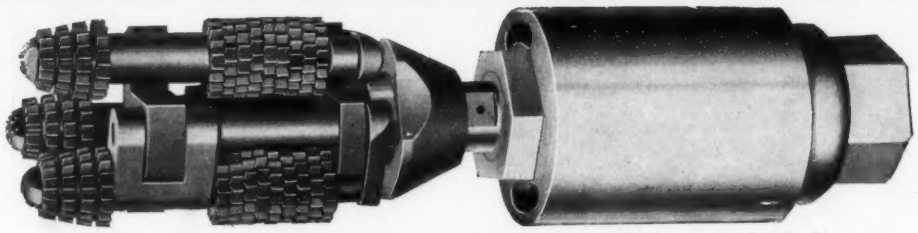
Mexia, Texas.—The Transcontinental Oil Company has placed its portable absorption gasoline plant in the Nigger Creek field in operation, with an average daily yield of about 5000 gallons of gasoline. This plant consists of two units, and represents an investment of approximately $150,000. It is located on the A. E. Rosson farm in Lot No. 28, and is the only plant in the field.

Corrosion Bulletin

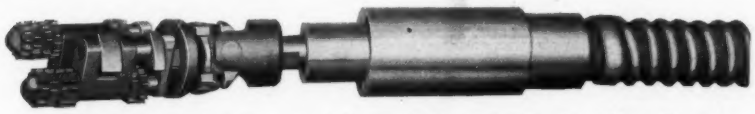
Corrosion, its causes, and methods of prevention are described in a new booklet issued by Quigley Furnace Specialties Company, 26 Cortlandt Street, New York City.

"Hytempite in the Power Plant," is another bulletin recently printed. It illustrates and describes some of the many successful applications of this refractory cement in construction and maintenance.

Copies of either or both bulletins may be had upon application.



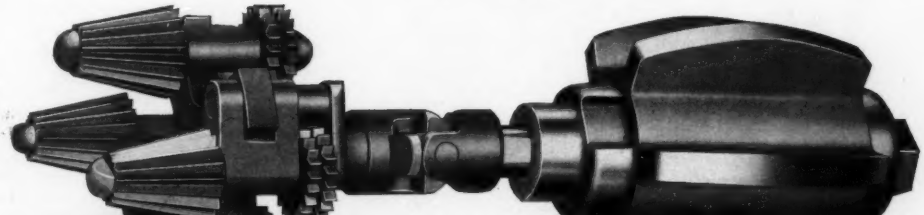
Lagonda Air Driven Cleaner for 3-inch I. D. tubes in cracking still furnace, equipped with long surface Quick Repair Head



Lagonda No. D-153 Cleaner for 2-inch curved pipe, as used in the residuum lines.

Lagonda Cleaners are at work in oil refineries everywhere, cleaning all sorts of tubes and pipes —large or small, straight or curved. They are furnished with air-driven motors and cutting head equipment to suit the purpose. Our experience in the application of tube cleaners to refinery work is at your service.

Extension piece used between Universal Joint and Drill, increases the cutting range of Drill in large size tubes.



No. D-344 Lagonda Cleaner with sled runners, as used in 7¾-inch I. D. curved vapor lines in Dubbs stills

The Lagonda Mfg. Co.
SPRINGFIELD, OHIO.
FUEL SAVING SPECIALISTS

X-1415

NEW YORK, CHICAGO, PHILADELPHIA, BOSTON, PITTSBURGH, CLEVELAND, CINCINNATI, DETROIT, SYRACUSE, BALTIMORE, ST. LOUIS, KANSAS CITY, DENVER, DALLAS, ATLANTA, SAN FRANCISCO, MONTREAL, LONDON.

Makers of Lagonda Boiler Tube and Condenser Cleaners, Tube Cutters, Cap and Header Reseating Machines, etc.

Statement 4
SUMMARY OF ESTIMATED POTENTIAL GASOLINE PRODUCTION
(Gallons)
Plant No. 32

Year	Lease No. 1	Lease No. 2	Lease No. 3	Lease No. 4	Lease No. 5	Lease No. 6	Lease No. 7	Lease No. 8	Lease No. 9	Lease No. 10	Total
1922	296,523	913,311	89,261	278,542	183,441	167,576	125,006	174,449	141,717	96,566	2,466,392
1923	1,205,302	2,508,855	580,921	1,113,832	1,054,702	287,434	126,189	397,941	631,807	193,170	8,100,153
1924	1,013,962	1,817,790	1,236,371	955,482	977,038	462,256	441,009	521,841	1,036,931	391,276	8,853,956
1925	838,851	1,106,304	1,125,641	796,876	828,018	494,497	421,254	323,416	999,048	425,034	7,358,939
1926	684,400	898,900	1,080,000	660,800	696,000	572,000	470,400	244,800	940,000	427,500	6,674,800
1927	562,800	738,100	980,000	546,000	562,800	548,100	484,500	230,000	893,200	411,600	5,957,100
1928	457,500	614,100	897,000	445,300	457,500	511,200	442,200	243,360	824,100	380,250	5,272,510
1929	377,200	514,800	817,600	368,000	369,000	471,000	399,600	278,200	765,000	346,750	4,707,150
1930	312,400	425,850	752,000	308,850	303,600	433,500	348,300	255,150	713,400	312,000	4,165,050
1931	262,260	358,000	696,000	257,600	242,730	398,200	315,000	228,800	655,600	285,360	3,699,550
1932	225,400	308,750	634,800	220,190	197,960	374,400	282,125	198,900	604,500	257,600	3,304,625
1933	193,640	264,670	586,850	190,740	164,800	340,000	254,800	174,070	558,600	229,890	2,958,060
1934	165,850	227,700	550,800	164,300	139,100	325,500	230,625	153,850	525,300	209,100	2,692,125
1935	146,720	200,880	508,800	143,000	118,720	301,630	210,790	136,800	492,200	186,560	2,446,100
1936	128,800	179,200	481,800	127,680	100,050	281,250	192,500	120,000	470,400	167,200	2,248,880
1937	113,280	157,080	456,000	112,320	86,140	266,800	175,560	109,200	438,150	153,900	2,068,430
1938	99,600	138,060	427,050	99,600	72,000	253,340	159,120	95,230	413,000	140,400	1,897,400
1939	89,060	124,630	403,200	89,060	61,000	238,875	147,600	86,240	386,400	129,000	1,755,065
1940	79,360	116,850	378,200	79,360	52,080	225,000	136,400	78,880	364,780	118,340	1,629,250
Totals	7,252,908	11,613,830	12,682,294	6,957,532	6,666,679	6,952,558	5,362,978	4,051,127	11,854,133	4,861,496	78,255,535

Accounting System for the Natural Gasoline Department

(Continued from page 46)

ture, etc. Therefore, the estimate of future gasoline production should be made for each property rather than for the plant as a whole. The future production should be estimated for the life of the property unless the contract under which casinghead gas is being taken, is terminable without a provision for renewal in which case the future production should be for the term of the contract.

The future recoverable casinghead gas reserves for each property is the base for estimating the future gasoline production. The monthly production record of gas taken from each property serves as a basis for the construction of a casinghead gas production decline curve. The average casinghead gas monthly or yearly production in thousand cubic feet per well is plotted on logarithmic cross-section paper and extended to the economic minimum of production in a manner similar to the construction of an oil production decline curve. Due consideration should be given to the operating conditions and hazards peculiar to the field from which the gas is taken.

Experience has shown that during the operating life of an oil well in most fields, the casinghead gas becomes richer in gasoline content as the oil and gas production declines. This is due to the more rapid vaporization of the hydrocarbons as a result of the decreasing rock pressure. The gallons of gasoline content per thousand cubic feet of casinghead gas is determined by actual physical tests, on each property, for the purpose of determining royalties. These tests are made at least quarterly and sometimes at more frequent intervals. From these tests, a gallons-per-thousand-cubic-feet-of-gas-per-test curve is constructed. If sufficient tests are not available in order to determine the trend of the curve, statistics from an older producing area similar to the area in question would be used. The curve is termed the G. P. M. curve.

The estimated future recoverable casinghead gas as determined from the gas production decline curve is then reduced to terms of gasoline by multiplying the number of thousand cubic feet of gas by the gallons of gasoline per thousand cubic feet as shown by the G. P. M. curve for each year. The result is the estimated future potential gasoline production in gallons for each casinghead gas producing property. The past and estimated future potential gasoline production in gallons for each property is then summarized by years for the purpose of determining the potential gasoline production for the plant. (Statement 4).

The potential gasoline production of the plant varies from the actual number of gallons of gasoline produced by the plant according to the plant's efficiency of operation. This difference is expressed as the plant efficiency factor, and is the ratio of the actual gasoline production to the potential gasoline production.

The ultimate gasoline production of the plant is determined by applying the plant efficiency factors to the potential gasoline production for each year (Statement 5).

Statement 5
SUMMARY OF ULTIMATE GASOLINE PRODUCTION
(Gallons)
Plant No. 32

Year	Potential Gasoline Production Gallons	Efficiency Factor	Estimated Future Efficiency Factor	Gasoline Produced	Production Estimated Future	Gallons Ultimate
1922	2,466,392	.973		2,399,799		
1923	8,100,153	1.04248		8,444,247		
1924	8,853,956	1.06197		9,402,636		
1925	7,358,939	1.08413		7,978,047		
1926	6,674,800		1.10		7,342,280	
1927	5,957,100		1.10		6,552,810	
1928	5,272,510		1.10		5,799,761	
1929	4,707,150		1.10		5,177,865	
1930	4,165,050		1.10		4,581,555	
1931	3,699,550		1.10		4,069,505	
1932	3,304,625		1.10		3,635,088	
1933	2,958,060		1.10		3,253,866	
1934	2,692,125		1.10		2,961,338	
1935	2,446,100		1.10		2,690,710	
1936	2,248,880		1.10		2,473,768	
1937	2,068,430		1.10		2,275,273	
1938	1,897,400		1.10		2,087,140	
1939	1,755,065		1.10		1,930,572	
1940	1,629,250		1.10		1,792,175	
Totals	78,255,535			28,224,729	56,623,706	84,848,435

Statement 6
DEPRECIATION SCHEDULE
Plant No. 32

		1922	1923	1924	1925
(1)	Estimated future gasoline production at the beginning of the period (gallons)		82,448,636	73,235,360	63,219,942
(2)	Adjustments on account of additions (gallons)	84,848,435			
(3)	Adjusted estimated future gasoline production at beginning of the period (gallons)	84,848,435	82,448,636	73,235,360	63,219,942
(4)	Production for the period (gals)	2,399,799	9,213,276	10,015,418	8,291,758
(5)	Depreciation base at beginning of the period		$1,542,595.36	$1,497,144.51	$1,292,399.32
(6)	Additions to depreciation base for the period	1,587,495.60	142,896.15		
(7)	Total depreciation base	1,587,495.60	1,685,491.51	1,497,144.51	1,292,399.32
(8)	Unit cost	.018710	.020443	.020443	.020443
(9)	Depreciation sustained	44,900.24	188,347.00	204,745.19	169,508.41

Computation of Depreciation

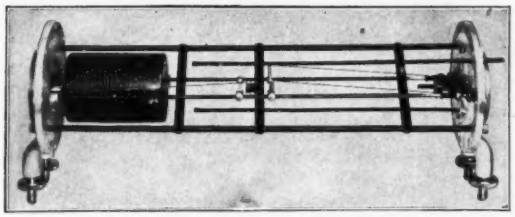
As hereinbefore stated the plant and equipment accounts are subdivided between tangible equipment and intangible cost. Property having a residual value is considered tangible equipment, while property not having a residual value is considered intangible cost. Intangible cost of the plant includes the cost of casinghead gas contracts, expenditures made in construction such as labor, teaming, freight, masonry construction, etc., and in the case of the acquisition of a plant already constructed, the excess of inventory, or appraisal, value of the plant over the cost thereof.

The residual value of the tangible equipment varies with the life of the plant. Other things being equal the residual value of tangible equipment would be of more value, upon dismantling, in a plant which had an operating life of ten years than in a plant which had an operating life of fifteen years. The total investment in the plant less the residual value of the tangible equipment is the depreciation base.

A depreciation schedule (Statement 6)

THE "R S" NICK OF TIME PRECISION S. G. BALANCE

Patent Applied For



Improved type of strictly portable and accurate Balance. THIS MACHINE IS BALANCED INSIDE THE CASE WITHOUT REMOVAL OF BALANCE MECHANISM. The Float is of pressed steel construction, the entire apparatus is lacquered inside and out to prevent corrosion except the Torsion Spring and Truss Wires which are Gold Plated to withstand acid reactions.

Among the many other new and exclusive features which mark the R. S. Balance are:

Removable purging tubes. Both End Rings are interchangeable and easily unscrewed. Machine may be leveled in the same manner as a Transit, adjustable leg screws. The ease of making the machine portable by adjusting a locking bar on each end.

Each, $125.00

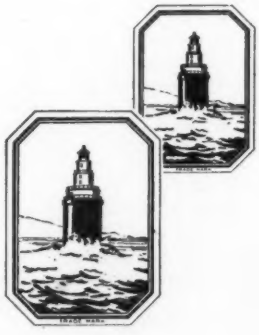
THE REFINERY SUPPLY COMPANY

Largest Scientific Material House in the Southwest

Tulsa, Oklahoma
4th and Detroit

Dallas, Texas,
917 Santa Fe Building

THE R.S.C. SERVICE ACCURACY TULSA



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Manufacturers of Paints, Varnishes, Enamels, Biturine Coatings

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816 Western Avenue

NEW YORK
15 Moore Street

PORTLAND
51 First Street

BALTIMORE
600 E. Lombard Street

TULSA
P. O. Box 1483

is then prepared showing the following:

(1) Estimated future gasoline production at the beginning of the period in gallons.
This is the estimated future gasoline production of the plant at the beginning of each period.

(2) Adjustments on account of additions during the period in gallons
The ultimate gasoline production of additional casinghead gas producing properties acquired during the period would be added. If a casinghead gas contract is canceled, or a producing property is abandoned, the remaining ultimate gasoline production from the date of contract cancellation or property abandonment would be deducted.

(3) Adjusted estimated future gasoline production at the beginning of the period in gallons.
This is the algebraic sum of the estimated future gasoline production at the beginning of the period and adjustments during the period.

(4) Gasoline production for the period in gallons.
This is the net production of the plant for the period.

(5) Depreciation base at the beginning of the period.

(6) Additions to the depreciation base during the period.
This is the net capital additions to the plant after deducting therefrom the amount of the residual value of the tangible equipment.

(7) Total depreciation base.

(8) Unit cost.
The unit cost per gallon of gasoline produced is determined by dividing the total depreciation base by the adjusted estimated future gasoline production at the beginning of the period.

(9) Depreciation sustained.
The net gasoline production in gallons for the period multiplied by the unit cost per gallon is the depreciation sustained during the period.

Californians Building Panhandle Plant

Los Angeles.—The MacMillan Petroleum Products Company with offices here and a 4000 barrel refinery at Long Beach, will start work immediately on the construction of a 10,000 barrel refinery near Borger, Texas, in the new Panhandle oil field.

R. S. MacMillan, president of the company, who returned from the Panhandle recently, announced that the new plant would be rushed to completion at the earliest possible date. The plant will be of the tube still and dephlegmator type and the fractionating equipment will be installed by the engineering firm of Boner and Sheldon of Los Angeles. The new refining company will be called MacMillan Petroleum Corporation.

Inexpensive Rack Keeps Gaskets In Order

"WHAT'LL we do with the gaskets?"

Because of their peculiar circular and elliptical shapes, and the great number of sizes, types, and kinds of gaskets required in the operation of a large refinery or, oil producing property, the problem of handling and storing ready cut and prepared gaskets assumes some importance. The great variety of circular gaskets, cut to various diameters, with both holes provided at different distances, as required for various pieces of equipment about the plant do not lend themselves readily to storage.

The elliptical styles of gaskets, varying in size, as well as the various other shapes, become more difficult in their handling or storage problem than the circular types,—and either, or any style, shape, or kind, of gasket becomes a nuisance when packed in bins, when stacked in neat piles on shelves, etc. Few gaskets will pile in stacks with any degree of order unless the cord about each bundle, as shipped, is permitted to remain fast, and this cord is soon lost, thrown away, etc.—all of which usually terminates into the practice of handling gaskets the best way possible under the conditions,—which really means, generally, that the gasket bin is a pile of assorted gaskets, and selection of a certain type or style results in a "search until you find it."

Construction Details

The home made, cheaply constructed, gasket rack pictured herewith, as built by the storekeepers at the Richfield Oil Company's Hynes, California, warehouse, solves practically every problem in the handling of these very important items of material. It is estimated that this rack was constructed at a cost of $10.00. Certainly it takes care of a great amount of material in an orderly, visible, and efficient manner.

Gasket Rack

The rack, as shown in the photos, requires but little space in the storehouse. The height is about four and one-half feet, length is about six feet, and the projecting pipes on which the gaskets are strung extend 18 inches outward from the center cross member making the width of the rack only three feet. The device is constructed entirely of "two by fours", three lengths of which are six feet, and the same material forms the upright end braces, four and one-half feet in height. Add to this the four short pieces employed as bracing length and the wooden portion of the rack is accounted for.

The extending arms which center in the wooden beams are made of three-eighths-inch pipe fitting tightly in the holes bored through the wood beams. The uppermost cross member accommodates nine of these iron pipe members, and thus the top brace takes care of 18 different sizes or types of the smaller gaskets, making these small tiems easily accessible when distributed from the warehouse, and lending rapidity in counting the number of the items for inventory purposes. The second cross member, which forms the second "shelf", is equipped with five extending arms, which accommodates ten sizes and styles of gaskets of medium size. The larger gaskets employed in such work as boiler manhole gasketing and still heads, are stored or filed on the extending arms of the bottom cross member. There are three iron pipe provided, which care for six styles or sizes of larger gaskets.

Space Small

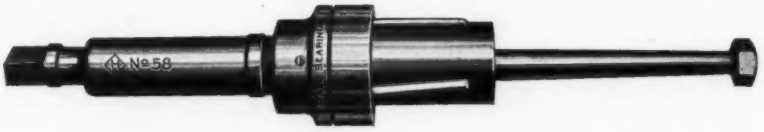
In this manner the rack, requiring but little of the warehouse floor space, provides storage facilities for 34 types, or sizes of gaskets. The additional advantage of accessibility is important, for no time is lost in searching for any particular gasket, since all types are in plain view.

In addition, the entire stock of numerous types of gasketing items is handled in such a manner that stock on hand for inventory or checking purposes can be accurately secured in a very few minutes.

It is obvious that this method is about the simplest storage method for gaskets possible, for it is difficult to find bin room, etc., for 30 to 40 various types of such items, and more than difficult to keep such stock in order in the bins. The rack probably concentrates these materials in the smallest possible space in the warehouse.

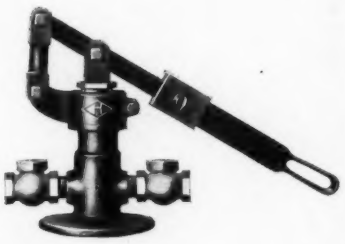
The Walter F. Lummus Company, Boston, Massachusetts, announce the addition of G. H. Dillon to their sales department. Mr. Dillon will handle the sales of the Lummus low temperature refining system, with headquarters at Boston.

HEAVY DUTY EXPANDERS FOR STILL TUBES



TOOLS FOR THE OIL INDUSTRIES

Hydraulic Pressure Pumps, 8000 pounds
Tube Expanders for Cracking Still Tubes
Hydraulic Pressure Pumps, 2000 pounds.
Tube Expanders for Condenser Tubes
Hydraulic Pressure Pumps, 500 pounds.
Tube Expanders for Steam Boilers
Screw Punches for Structural Shapes
Tube Expanders for Pipe Work
Screw Punches for Plate Work
Flaring Tools for Still Tubes
Beading Tools for Still Tubes
Hydraulic Jacks
Hydraulic Punches



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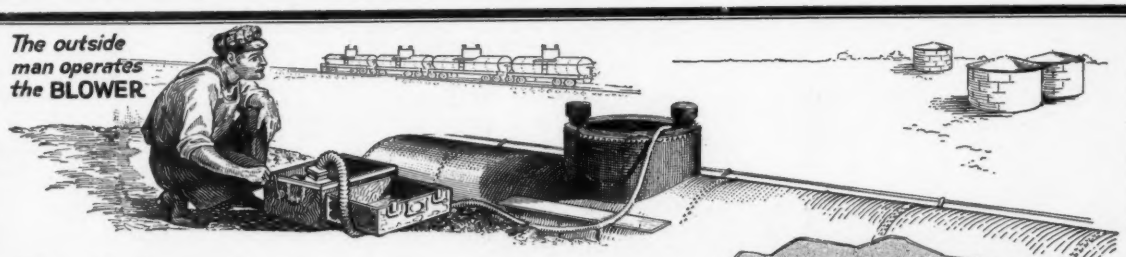
Wilmington, Del.

Established 1870 Expanders since 1884



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FRESH-COOL-AIR

—and he'll work with greater ease, comfort and safety.

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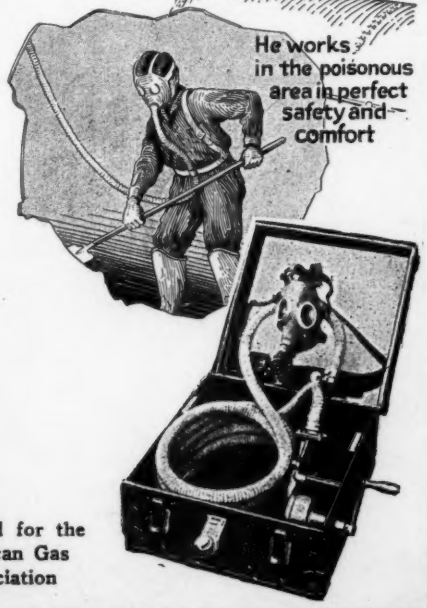
HOSE MASK

Supplies a continuous stream of fresh air to workers in Tank Cars, Oil Tanks, or in any confined gaseous space.

Send for Bulletin No. 99F for complete information on this and other types of Hose Masks



Mine Safety Appliances Co.

Braddock Ave. & Thomas Blvd. Pittsburgh, Pa.

Standard for the American Gas Association

Average Depreciation of Refinery and Gasoline Equipment

(Continued from Page 38.)

11. Pumps at treating plant.

12. Machinery and equipment at continuous treating plant.

13. Miscellaneous rigging at continuous treating plant.

14. Machinery and equipment at loading rack.

15. Machinery and equipment at transfer pump house.

16. Machinery and equipment at lubricating oil agitators.

17. Elevators at contact filtering plant.

18. Pumps at contact filtering plant.

19. Motors and accessories at contact filtering plant.

20. Refrigerating machine.

21. Pumps at Shraples dewaxing plant.

22. Motors at Sharples dewaxing plant.

23. Sharples centrifuges at Sharples dewaxing plant.

24. Agitator-drive equipment at Sharples dewaxing plant.

25. Pumps and miscellanous equipment around lubricating oil reducing stills.

26. Pumps and motors in compounding and barrel house.

27. Barrel-washing machinery.

28. Air heaters in barrel house.

29. Pumps and pumping units in boiler house and in use in water system.

30. Machinery and equipment in use in air compressor plant and electric power plant.

31. Machinery and equipment in use throughout fire protection system.

32. Fire truck and miscellaneous fire protection equipment.

33. Machinery and equipment in use in machine, welding, blacksmith and carpenter shops.

34. Machinery and equipment in use in and around oil separator and pump house and around the refinery yard itself.

35. Machinery and equipment around the refinery absorption plant.

36. Sanitary and sewer system in use around the absorption plant.

36. Sanitary and sewer system in use around the absorption plant.

37. Ohio locomotive crane.

38. Fuel oil wagon (overhead).

10 per cent yearly depreciation rate:

1. After-coolers in use in light oil batch treating agitators.

2. Tools and supplies used in and around the continuous light oil treating plant.

7 per cent yearly depreciation rate:

1. Fire stills proper, towers, oil and vapor lines, high and low pressure and exhaust steam lines, river water lines, recirculating water lines, water lines returning to reservoir, air lines, fuel and vacuum gas lines, miscellaneous pipes and fittings, temperature recording equipment, equipment for heating building, sanitary and sewer system, electrical and telephone systems—all of the equipment just mentioned being part of that used in and around the crude still batteries.

2. Oil and steam lines used in transfer pump house.

3. Oil lines and high pressure steam lines used in tank farm.

4. Fire stills proper, towers, oil and vapor lines, river water lines, recirculating water lines, water lines returning to reservoir, fuel and vacuum gas lines, air lines, miscellaneous equipment, equipment for heating buildings—all of the equipment just mentioned being part of that used in and around the re-run distillate batteries.

5. Oil and vapor lines, high pressure and exhaust steam lines, river water lines, recirculating water lines, water lines returning to reservoir, air lines, gas lines (fuel), oil lines (fuel), equipment for heating building, tools and supplies, pyrometers and all recording equipment, pipe conduits—all of the equipment just mentioned being part of that used in and around the pressure stills.

6. Oil lines, high pressure and exhaust steam lines, river water lines, equipment for heating building—all of the equipment just mentioned being part of that used in and around the light oil agitators. The same depreciation rate is used for the same equipment in use in the continuous light oil treating plant, with the exception that air lines are not used in the latter.

7. Equipment for heating that part of the office building housing the shipping department.

8. Oil lines, high pressure and exhaust steam lines, air lines, high pressure gas lines, tools and supplies—all of the equipment just mentioned being part of that in use in and around the loading rack.

9. Oil lines, high pressure and exhaust steam lines and air lines in use in the transfer pump house.

10. Oil lines; high pressure and exhaust steam lines, river water lines, air and acid lines, equipment for heating buildings, tools and supplies—this equipment being part of that used in and around the lubricating oil agitators.

11. Foster pipe still, Sweetland filters, oil, air and high pressure gas lines, high pressure and exhaust steam lines, recirculating and river water lines, gas lines (fuel), gas lines (vacuum), equipment for heating buildings, tools and supplies—the equipment just mentioned being part of that used in and around the lubricating oil contact filtering plant.

12. Oil lines within plant and oil lines to tank farm, high pressure steam lines within plant and high pressure steam lines to tank farm, low pressure steam lines, river water lines, recirculating water lines, water lines recirculating to reservoir, air lines, brine lines, ground connections for tanks, equipment for heating building, tools and supplies—all of the equipment just mentioned being part of that used in connection with the operation of the Sharples dewaxing plant.

13. Fire stills proper, oil and vapor lines, high and low pressure and exhaust steam lines, river water lines, recirculating water lines, water lines returning to reservoir, gas lines (fuel), gas lines (vacuum), equipment for heating building—all of this equipment being part of the lubricating oil reducing stills.

14. Oil lines, high and low pressure steam lines, air and caustic lines, river water lines, recirculating water lines, Toledo scales, stencil machine, freight elevator, tools and supplies, equipment for heating building—all of this equipment being part of the compounding and barrel house.

15. Boilers and superheaters, boiler house feed unit, oil and air lines, high and low pressure steam lines, river water lines, recirculating water lines, gas lines (fuel), miscellaneous equipment, sanitary and sewer system, tools and supplies—this equipment being part of that used in the boiler house.

16. Low pressure steam lines, gas lines (fuel), recirculating water lines, river water lines, tools and supplies—this being part of the equipment of the water system (reservoir and pumphouse).

17. Recirculating water lines, water lines returning to reservoir, and river water lines (outside pipes and fittings)—this equipment being part of the reservoir and pumphouse proper.

18. River water lines; equipment for heating building, and telephone system—this being part of the equipment used in the refinery transfer pumphouse.

19. Air lines, river water lines, water lines returning to reservoir, high pressure and exhaust steam lines, miscellaneous hardware, equipment for heating building—this equipment being part of that used in the air compressor plant.

20. Superheater, air lines, river water lines, high and low pressure steam lines, equipment for heating building, tools and supplies, telephone system—all this being part of the equipment in the electric power plant.

21. Tools and supplies used in electric shop.

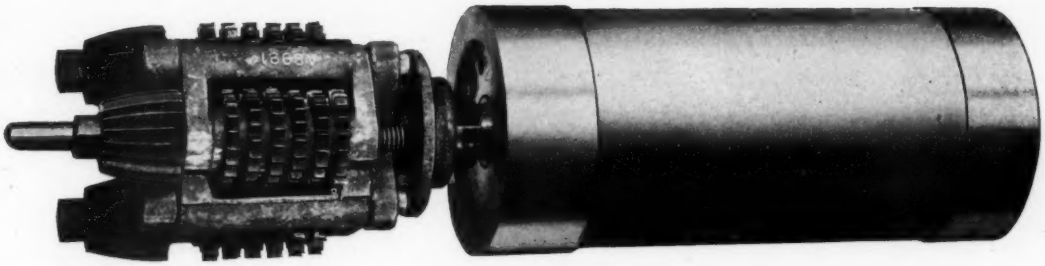
22. Apparatus and chemicals, and equipment for heating building in laboratory control department.

23. Small agitators and filters, miscellaneous laboratory equipment, oil, gas, vacuum, river water and high pressure steam lines, equipment for heating building—this being part of the equipment of the laboratory experimental department.

24. High pressure and exhaust steam lines, river water lines, air lines, foamite lines, steam smothering lines, equipment for heating foamite building—all this being part of the Foamite fire protection system.

25. Water and gas lines, tools and supplies, equipment for heating build-

ROTO TUBE CLEANERS



Roto Air-Driven Heavy Duty Cleaner
For

CRACKING STILLS

THE ROTO CO. Sussex Avenue and Newark St., **NEWARK, N. J.**

WALSH FIRE BRICK

FROM COAST TO COAST

WALSH FIRE CLAY PRODUCTS CO.

ST. LOUIS
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NEW YORK
220 FIFTH AVE.

ing—this being part of the equipment of the fire station proper.

26. Miscellaneous yard supplies.

27. Steam and oil lines of the oil separator and pump house.

28. River water lines, gas lines, equipment for heating building and miscellaneous equipment and supplies used in the First Aid Station.

29. Equipment used in heating part of office building housing the yield, time-keeping and accounting offices, and telephone in yield and time-keeping offices.

30. Tools and supplies used in tool and supply house and salvage yard.

31. Equipment for heating that part of office building in which process superintendent's office and drafting room are located.

32. Air lines, river water lines, equipment for heating building and tools and supplies used in the machine shop.

33. Acetylene lines, gas lines (fuel), air lines, high pressure steam lines, and tools and supplies used in welding shop.

34. Gas lines (fuel), air lines, river water lines, and tools and supplies used in blacksmith shop.

35. High pressure steam lines, river water lines, air lines, gas lines (fuel), and tools and supplies used in paint shop.

36. High and low pressure steam lines, river water lines, air lines, gas lines (fuel), and tools and supplies used in carpenter shop.

37. High pressure steam lines, river water lines, air lines, gas lines (fuel), and tools and supplies used in pipe shop.

38. Oil, air, caustic, gas (both vacuum and low pressure) lines, high pressure and exhaust steam lines, river water lines, recirculating water lines, water lines returning to reservoir, miscellaneous lines, equipment for heating building, tools and supplies—this being part of the equipment in use in the refinery absorption plant.

39. Dump cars, high pressure, overhead steam lines, river water lines (overhead), air lines, gas lines (fuel), tools and supplies—this equipment being part of that in use with the industrial railroad.

Five per cent yearly depreciation rate:

1. Receiving house of one of the crude still batteries.

2. Tanks, condenser boxes, cooling boxes, miscellaneous steel work and miscellaneous carpentry and hardware work as used on the two crude still batteries.

3. Tanks, pipe conduits and miscellaneous carpentry and hardware used in the tank farm proper.

4. Tanks, condenser boxes, miscellaneous steelwork, miscellaneous hardware and carpentry, sanitary and sewer system, electrical and telephone systems used on one of the rerun distillate batteries.

5. Tanks, condenser boxes, cooling boxes, miscellaneous steel work, miscellaneous hardware and carpentry, sanitary and sewer system and lighting system as in use on the other rerun distillate battery.

6. Tanks, condenser boxes, cooling boxes, reservoirs, trenches and sumps, paving, miscellaneous steel work, miscellaneous hardware and carpentry, sanitary and sewer system, lighting power system and telephone system as in use on the pressure stills.

7. Agitators, tanks, acid blow cases, air receivers, separators, miscellaneous carpentry and hardware, sanitary and sewer system, and lighting system as in use on the light oil agitators.

8. Towers, tanks, miscellaneous steel work, miscellaneous carpentry and hardware, sanitary and sewer system and electrical system as used in the continuous light oil treating plant.

9. Sanitary and sewer system, furniture and fixtures, electrical and telephone system as in use in the different offices of the office building proper.

10. Loading rack, tanks, miscellaneous steel work, miscellaneous carpentry and hardware, sanitary and sewer system, and electrical and telephone systems as in use in connection with the operation of the loading rack proper.

11. Agitators, tanks, air receivers, heaters and coolers, acid blow cases, pipe conduits, dirt levees, miscellaneous carpentry and hardware, sewer system, and electrical system—all this being part of the equipment of the lubricating oil batch agitators.

12. Storage bin, hoppers, grating, tanks, separators, mixing agitators, cooling boxes, pipe conduits, miscellaneous steel work, miscellaneous carpentry, sanitary and sewer system, lighting and electrical power systems of the lubricating oil contact filtering plant.

13. Electric switches, circuit breakers, tanks, pipe conduits, miscellaneous steel work, miscellaneous carpentry, sanitary and sewer system, lighting, electrical power and telephone systems of the Sharples dewaxing plant.

14. Tanks, condenser boxes, cooling boxes, miscellaneous steel work, miscellaneous carpentry and hardware, pipe conduits, sanitary and sewer system, lighting and telephone systems of the lubricating oil-naptha reducing stills.

15. Tanks, agitators, pipe conduits, miscellaneous steel work, miscellaneous carpentry and hardware, sanitary and sewer system, lighting system and power lines of the compounding and barreling plant.

16. Stacks, breechings and flue, tanks and heating equipment, concrete hot wells, blow-off pits and conduits, miscellaneous steel work, miscellaneous carpentry and hardware, electrical and telephone systems—all this being part of the equipment in use in the boiler house.

17. Reservoir and hot wells, miscellaneous carpentry, lighting, power and telephone systems—all this represents part of the equipment used in connection with the water system (reservoir and pump house).

18. Miscellaneous steel work miscellaneous carpentry and hardware, sanitary and sewer system, electric lighting and power systems—all representing equipment in use in the refinery transfer pump house.

19. Air compressor plant building proper, and the following equipment that is a part thereof: Tanks, sanitary and sewer system and electrical system.

20. Miscellaneous steel work, miscellaneous carpentry, electric lighting and power systems—equipment in use in connection with the operation of the electric power plant.

21. Electric lighting and power and the telephone system of the electric shop proper.

22. Sanitary and sewer system and lighting and telephone system of the laboratory control department.

23. Electrical system of the laboratory experimental department.

24. Tanks, concrete mixing vat and pipe trenches, miscelleaneous steel work, miscellaenous carpentry, sanitary and sewer system, electric lighting and telephone systems—all being part of the equipment used with the fire protection system.

25. Refinery fences.

26. Sewer mains.

27. Telephone mains.

28. Separator and pipe conduits, and electric lighting and power system of the oil separator and pump house.

29. Sanitary and sewer system, and lighting and telephone systems used in connection with the First Aid Station.

30. Miscellaneous carpentry and hardware and the electrical system of the tool and supply house.

31. Electrical system of the salvage yard.

32. Furniture and fixtures and telephone system of the General Superintendent's office.

33. Sanitary and sewer system, furniture and fixtures, lighting and telephone systems of the Process Superintendent's office and drafting room.

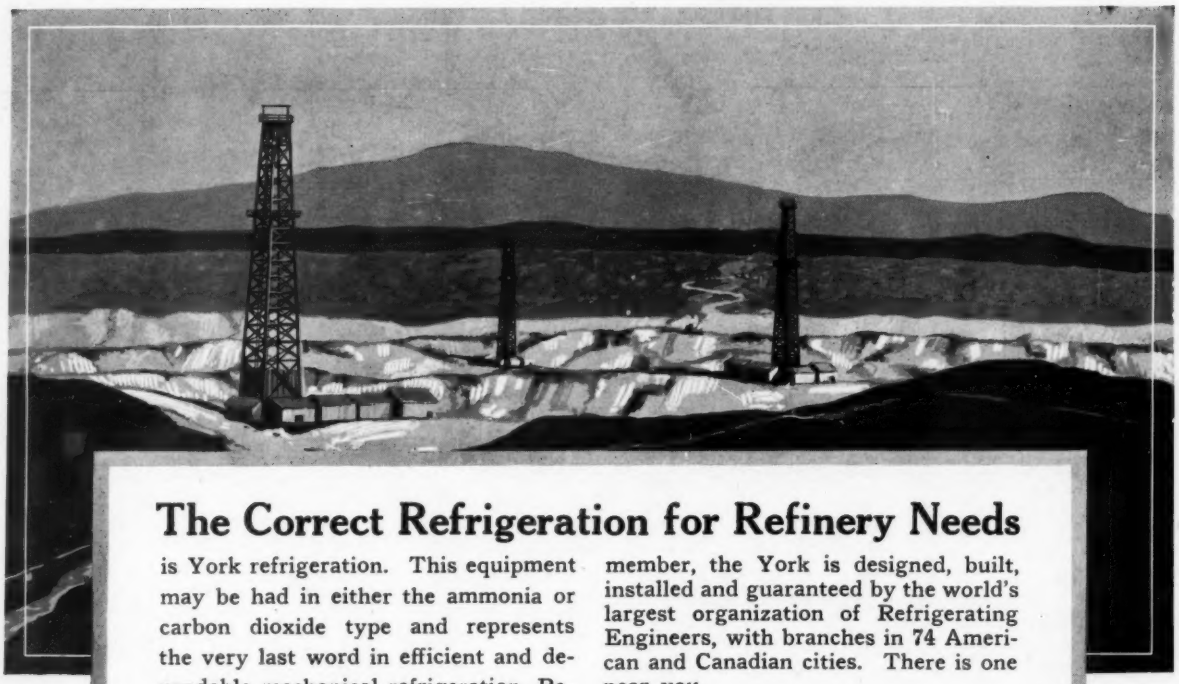
34. Telephone system of the plant office and laboratory.

35. Miscellaneous carpentry and electrical system of the machine shop.

36. Miscellaneous carpentry and hardware and electrical systems of the welding shop, blacksmith shop, paint shop and carpenter shop.

37. Miscellaneous carpentry and hardware of the pipe shop.

38. Tanks, towers; gas holder, concrete boxes, pits and sumps, miscellaneous steel work, miscellanecus carpentry and electrical and telephone



The Correct Refrigeration for Refinery Needs

is York refrigeration. This equipment may be had in either the ammonia or carbon dioxide type and represents the very last word in efficient and dependable mechanical refrigeration. Remember, the York is designed, built, installed and guaranteed by the world's largest organization of Refrigerating Engineers, with branches in 74 American and Canadian cities. There is one near you.

YORK MANUFACTURING CO.
YORK, PA. U. S. A.

GOETZE

Metal-Asbestos Gaskets *for* Modern Refinery Practice

Write for this 36-page "Guide"

Goetze Gasket & Packing Co.

28 Allen Ave., **New Brunswick, N. Y.**

systems—all this being part of the equipment of the absorption plant.

39. Narrow gauge railroad tracks.

Three per cent yearly depreciation rate:

1. All refinery buildings. (The buildings are all fireproof and of first class construction.)

2. Standard gauge railroad tracks.

Natural Gasoline Plant Equipment

In a number of the paragraphs preceding, where the specific rates of depreciation for refinery equipment as now being used by one refiner were given, mention was made of the rate of depreciation of the equipment in use at the refinery natural gasoline plant of this particular refiner. While these figures are believed to be fair enough so far as the equipment itself is concerned, and especially for a refinery natural gasoline plant, still it is not the writer's opinion that these figures can be taken as average depreciation rates on natural gasoline plants operating in production areas.

The depreciation rate of natural gasoline plants located in production areas varies greatly according to the estimated life of the field in which such plants are located. One might estimate an 8-year life for the plant, and a 20 per cent salvage value (20 per cent of the original cost of the plant)—thus fixing the yearly depreciation rate at 10 per cent. But, at the best, such a figure is merely an estimate—and hence must be considered as such. It is almost impossible for one to give accurately an average depreciation rate for natural gasoline plants, since so many variable factors enter into a determination of such rates.

A method of depreciating natural gasoline plants that is coming into favor more and more is to cause the yearly or monthly depreciation rate to bear a direct relation both to the volume of business done and to the remaining supply of raw material, upon the existence of which the continued operation of the plant depends. (See The Refiner and Natural Gasoline Manufacturer for June, 1926, "Depreciation and Depletion for Gasoline Plants," by A. B. Morris.)

This article has been written, primarily, with the idea of causing executives to give consideration to their own particular methods of depreciating various units and types of equipment in use in their own business, and to cause them to compare such depreciation rates and methods of accounting as they use both with what the writer considers to be average depreciation rates and those actually used by one refinery organization. Each organization will differ somewhat in smaller details—depending upon particular conditions of operation and maintenance—but fair depreciation rates on the equipment mentioned are believed to be as has been given in this article.

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The unusual is welcomed by Power Piping engineers. Years of experience in providing a suitable solution to some baffling problem has made this company an invaluable aid in meeting exactingly any requirement. And our service is economical as well. What is YOUR problem?
Power Piping Co.
Pittsburgh
Welded Steel Receivers for large refinery
TEST 1000

Dunn Issues Bulletin on Atomized Painting

Atomized Painting is the title of a new booklet published by the Dunn Painting Machine Company, 835 Howard Street, San Francisco. The booklet features Dunn Patented Painting Machines for spray painting.

It is claimed by the manufacturers that the machine atomizes the paint during the process of painting.

Distributors for the machine include: The Burrshel Company, Inc., 48 Front Street, New York City; H. Channon Company, North Wacker Drive and Randolph Street, Chicago, Ill.; The Chas. A. Strelinger Company, 149-165 E. Larned Street, Detroit, Michigan; Cleveland Tool and Supply Company, 1427 W. 6th Street, Cleveland, Ohio; W. S. Nott Company, Second Avenue N. and Third Street, Minneapolis, Minnesota.

Copies of the bulletin can be obtained from the company on request.

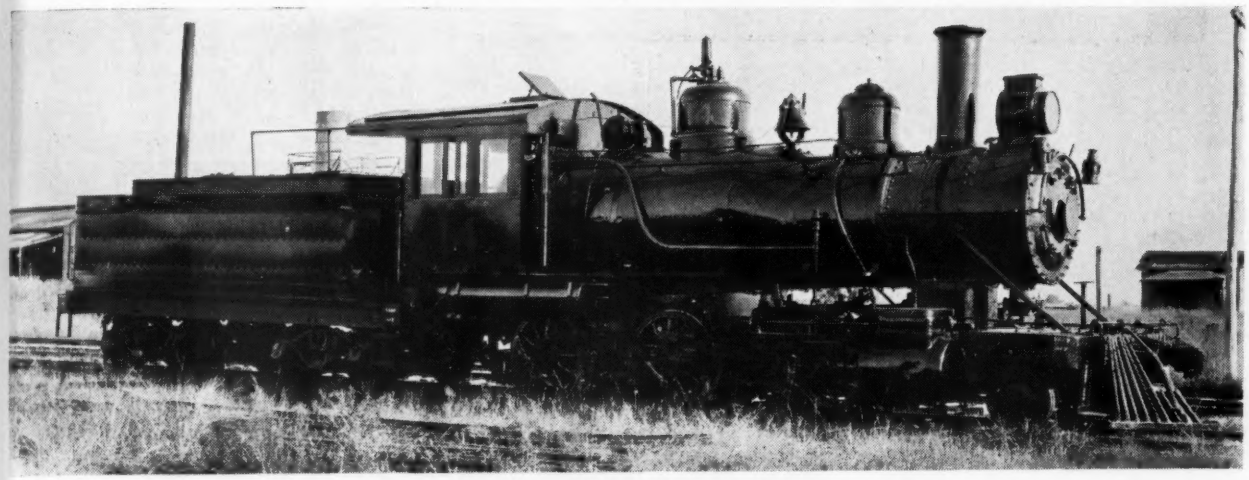
Ingersoll-Rand Issues Revised Bulletin

A new and revised edition of the Cameron single-stage double-suction, volute pump bulletin, form No. 7059, is now being distributed by Ingersoll-Rand Company, 11 Broadway, New York.

This bulletin describes these pumps completely, and shows various illustrations and drawings.

Copies are obtainable on request.

LOCOMOTIVE ENGINE FOR SALE



SPECIFICATIONS OF ENGINE 14

Class 8-30 D 643 Locomotive Engine having three pairs coupled wheels and a two wheeled truck in front.

Gauge 4 feet 8½ inches.
Fuel Oil
Cylinder 18 x 24 inches.
Drivers, Diameter 48 inches.
Working Pressure 180 lbs.
Boiler, Diameter 56 inches.
Type, Wagon Top.
Firebox 74 x 96 inches long. 40 inches wide.
Tubes, 209, diameter 2 inches, length 11 feet.
Heating service (approximately) Fire box 107 sq. ft., tubes 1194 sq. ft., total 1301 sq. ft.
Grate Area, 20.7 sq. ft.
Ratio to heating service 1 to 62.
Wheel base, driving 12 feet 6 inches; total engine 20 feet; engine and tender, 48 ft.
Weight (Approximate) drivers 101,000 lbs., total engine, 118,500 lbs., tender, 90,000 lbs.
In working order.
Ratio of Adhesion 4.1.
Tank capacity, 4500 gallons.
Height, 14 feet, width 9 feet 6 inches.
Headlight, round case. Power Brake, Westing house-American outside equalized Air Brake on driving and tender wheels.
9½-inch Pump. M. C. B. Coupler front and back.
Sander—AIR.
Built 1909.

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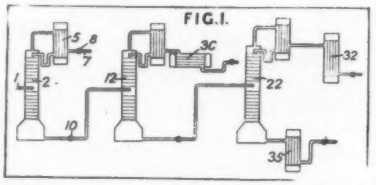
EXTRACTS OF REFINING TECHNOLOGY

Fractionation Number of Motor Fuels.—The characteristic number of the boiling point curve of a motor fuel, gasoline, is obtained by drawing a straight line at right angles to the temperature axis such that the two areas enclosed by this line, the boiling point curve and the uprights at either end of the curve are equal. The temperature which is indicated at the intersection of this line and the temperature axis is the characteristic number. In order to express more concisely the sharpness of the fractionation by which a gasoline was prepared a straight line is drawn through the boiling point curve, inclined to the temperature axis and cutting the curve in at least two points, such that the two areas (above and below the line respectively) enclosed by the line, the curve and the uprights) are equal. The inclination of this line to the horizontal is the fractionation number of the gasoline, and when this is used in conjunction with the characteristic number calculations of the composition of mixtures are possible and the efficiency of a fractionating process can be stated. Petroleum Zeitschrift, 1926, volume 22, pages 850-53.

* * *

Distilling Hydrocarbons and Producing Motor Fuels.—Casinghead gasoline and similar hydrocarbon liquids which contain very volatile fractions obtained from natural gases, by cracking processes or by distillation of crude petroleum, shale and the like, are divided



into three or more fractions by distillation under pressure in successive rectifying columns. The first fraction is gaseous at the ordinary temperature, the second fraction is suitable for blending with heavy gasoline and the third fraction constitutes a stabilized gasoline. The rectification may be carried out so as to obtain fractions of almost pure ethane, propane or butane.

Casinghead gasoline is introduced by a pipe 1 to an intermediate part of the column 2 heated at the base and surmounted by a reflux condenser 5. Gaseous products pass away through a valve 8 to a pipe 7 and unvaporized liquid passes through a valve 10 to a second column 12. The valves 8 and 10 are adjusted so as to maintain a pressure of about ten atmospheres in the column 2. The second column 12 is maintained at about four atmospheres and a product boiling between zero degrees C and 30 degrees C is obtained from the condenser 30 at the top of the column.

The liquid from the base passes into a third column 22 which works at a pressure of approximately one and one-half atmospheres. Constituents, which boil between the temperatures of 30 degrees C and 100 degrees C, are discharged by the condenser 32, and the residual oil from the base, drawn off through the cooler 35, constitutes a heavy gasoline.

In an alternative arrangement the first column separates the gaseous and light boiling fractions which are passed together after compression into a second column which works under a pressure of 45 atmospheres. British Patent No. 255,428.

* * *

Comparison of Adsorption Carbons.—Charcoal, which is made by heating a mixture of blood with ten per cent or 20 per cent of potassium carbonate at a temperature in excess of 750 degrees C, and then treated with hydrochloric acid, is more active than the product obtained by using calcium phosphate in the place of potassium carbonate. The presence of nitrogen is not essential, as substitution of sugar for blood does not impair the activity.

Carbonization of fir wood sawdust impregnated with zinc chloride gives a charcoal which closely resembles "car-

This cooling tower we installed for the Marland Refining Company at their Ponca City plant is the largest single atmospheric cooling tower in the United States.

COOLING TOWERS FOR REFINING PLANTS

In modern refineries the best practice is to have one large supply of cold water serving the various stills, interchangers and coolers. Since these various pieces of apparatus empty their water into the hot well at different temperatures it is important that the cooling water system be designed by experts in this field.

Our company is composed of engineers whose long experience with cooling water problems entitles them to your confidence. We have designed and built cooling towers and spray nozzle cooling systems for firms like Marland Refining Company, Humble Oil & Refining Company, Union Oil Company, Roxana Petroleum Company, and others equally well known.

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boraffin." If ordinary charcoal is heated in a vacuum or out of contact with oxidizing gases, its activity is increased only slightly or not at all. Activation by heating in a current of steam yields a carbon very similar to "norit" the activity being greater the larger the quantity of steam employed. In this process the charcoal loses hydrogen.

Activation by means of carbon dioxide should be carried out at approximately 1000 degrees C, and the charcoal should be as finely divided as possible.

"Supernorite" is apparently made by activating wood charcoal with furnace gases in this manner. In general, there is no relation between the purity of the inactive charcoal and the activity of the product that is obtained from it. The activated carbons prepared as described above are very complex in composition, but in general contain less hydrogen than ordinary wood charcoal. Bases are readily adsorbed and acids to a slightly less degree, while neutral salts of the alkali metals are not adsorbed at all.

The order of the adsorptive powers of the various carbons for a given substance varies with the substance used, but in general substances with relatively small molecules, such as iodine, are adsorbed to a much greater extent than those with larger molecules, for example quinine, this being probably due to the fineness of the capillaries. Koll. Chem. Beihefte, 1926, volume 22, pages 345-420.

* * *

Determining Calorific Power of Gasoline.—In determining the calorific power of gasoline, especially aviation gasoline, the liquid cannot be weighed satisfactorily in the ordinary open crucible of the Mahler bomb, even when a layer of kieselguhr or the like is used. Introduction of the liquid into the bomb in a sealed tube is also inexpedient, since if the point of the bulb is broken at the moment the bomb is closed, ignition of the liquid by the wire seldom occurs, while rupture of the bulb in the closed bomb by the pressure of the oxygen often results in the formation of a detonating gaseous mixture.

A convenient plan is to weigh the gasoline in a small cylindrical gelatine capsule such as is used by pharmacists, the igniting wire being passed through two needle holes in the lid of the capsule, so that it can be hung from the hook of the balance pan. The capsules should be stored in a closed vessel to keep their moisture content constant, and allowance must be made for their mean calorific value, this being determined beforehand.

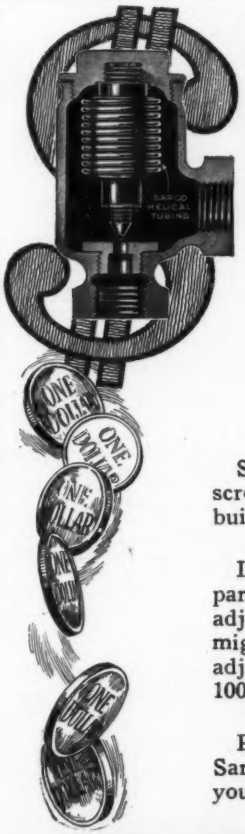
With benzene and toluene for which Landolt and Boernstein's tables give the calorific value 10,025 and 10,160 respectively, the values obtained by the above procedure were 10,038 and 10.052 for the first case and 10,151 and 10,172 for the second case. Three determinations with a sample of aviation gasoline gave the values of 11,034, 11.005 and 11,021 calories. Giornale Chimica Industr. Applicata, 1926, volume 8, pages 119 ff.

* * *

Increase in Viscosity of Oils Subjected to Electric Discharge.—When mineral oils are subjected to a silent electric discharge an increase in viscosity takes place. With saturated hydrocarbons this is accompanied by evolution of hydrogen. The increased viscosity is attributed to the formation of new compounds by the union of two molecules which have lost hydrogen atoms. The method may be used for the preparation of hydrogen of exceptional purity. Hydrogen can also be obtained from inorganic compounds by similar treatment. Wiss. Veroeff. Siemens-Konz., 1926, volume 5, pages 160 to 166.

* * *

Electrical Precipitation in Oil Distillation.—An interesting article has appeared in Przemysl Chemiczny, volume 10, pages 25 to 28 on the possibility of using electrical precipitation methods in the distillation of crude oil. It is known that when petroleum is distilled with a current of steam it is necessary to reckon with a mechanical carrying along of particles of liquids with the distilled vapors and the distilling medium. These small drops of liquid are carried along with the vapors into the condenser and are there mixed with the condensate which is of course contaminated with them. It appears that a successful method of removing these



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fine particles of liquid from the vapors before they reach the condensers is to subject the mixture to electrical discharge. Tests on this process have been carried out in the laboratory and an electrical precipitating device was built into the dephlegmator. The results showed that when electrical precipitation was employed, the color of the distillate was lighter than otherwise. Complete details of the manner of using this process are given in the criginal article.

* * *

Examining Transformer Oils After Exposure to Light.—Seven transformer oils formed a sludge after exposure to light in closed flasks for one and one-half years and developed a strong odor of the lower fatty acids. An increase occurred in the tar and acid values, thus being especially marked in two American oils which had not been refined with sulphuric acid, and in a well-refined Russian oil.

Three regenerated oils formed only a trace of sludge, with slight deterioration. An American non-sludging oil decreased in tar value from 2.1 to 0.08 and in acid value on the blown oil from 2.1 to 0.07, similar decreases being observed by preserving this oil out of contact with light for a similar period. Attention is drawn to the danger of storage or transport of transformer oils in light glass vessels, this being the cause of many discrepancies in the analysis of samples. Petroleum Zeitschrift, 1926, pages 1024 to 1025.

* * *

Desulphurizing Petroleum. — Tests have shown that good results are obtained by the use of concentrated nitric acid for this purpose. The acid has the effect of oxidizing the organic sulphur compounds to sulhpur dioxide. It also precipitates the asphalts and higher aromatic substances, the latter being present in the sludge in the nitrate condition. The excess of sulphur dioxide is neutralized by after-treatment with alkali and magnesium and the nitro compounds are reduced and the resins are dissolved. Quim et Ind. volume 2, page 92.

* * *

Higher Boiling Constituents of Synthol.—The higher boiling constituents of "synthol" contain small quantities of viscous oils which can be acetylated and therefore contain hydroxyl groups. The least volatile constituents are solid and asphaltic. Traces of a solid paraffinic substance are also obtained. Abhandl. Kennt. Kohle, volume 7, pages 75 to 77.

Wm. "Bill" Ray, superintendent of natural gasoline plants in Texas for the Magnolia Petroleum Company with headquarters at Olden, has been transferred to the Dallas office of the company and placed in charge of Magnolia's gasoline plants throughout the Mid-Continent district. Heretofore the natural gasoline plants have been under the jurisdiction of the production departmnet.

Warehouse Buys and Sells to Supply Plant With Equipment

(Continued from Page 36.)

salvage department which reclaims any or all materials throughout the plant which has once been used. This division is so watchful over their work and so strict in the determination of the quality of such reclaimed or salvaged material, that upon its receipt in the storehouse it is handled, not as salvaged items, but as new material and it is so entered upon the storehouse inventory. The reasoning here is that if it is not as good as new material, it is not worth using at all. The reclaimed material is, however, for obvious reasons, pushed back into service as rapidly as possible.

The result of such practices and policies as prevail with the Standard's El Segundo refinery storehouse department is that its invetnory is always as low as is practical for efficient operation of the plant. The expense of storehousing is reduced to the minimum, and the service of the storehouse to the large and busy plant is always at its best. "We're out of that item" is an expression that is never employed at this warehouse, for the perpetual inventory, and the continuous replacement practice eliminates the chance of delaying the work of any department on the plant yard—and "Sure, it will be right out" is the answer to all inquiries for material.

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Corrosion—An Economical Refinery Problem

(Continued from Page 62.)

tubes are often used in connection with steam stills. Where water velocity is low allowing concentration of dissolved gases and deposition of suspended matter, and condensers are overworked, the tubes in hot section will corrode through (in isolated holes) from water side in a year, and the half-inch steel shells leak at top in about the same period. Tubes of high nickel content are being tried; also a test is being made on the effect of electrical contact by making good contact with tube sheet at both ends, insulating one end, and insulating both ends of tubes. Mud deposits from hot sections have shown 5 per cent copper, on analysis.

Steam condensers at power plant where water velocity is higher, show a uniform loss of 25 per cent in tube thickness in two years with about 3 per cent failure in that time; 95 per cent of failure was due to split tubes which is a manufacturing defect.

Steam condensers on ships, where temperatures are higher due to poorer vacuum, show much greater loss by pitting. The cast iron shell of one of these condensers recently examined, had been in service 25 years and was still very servicable.

Tank Ships

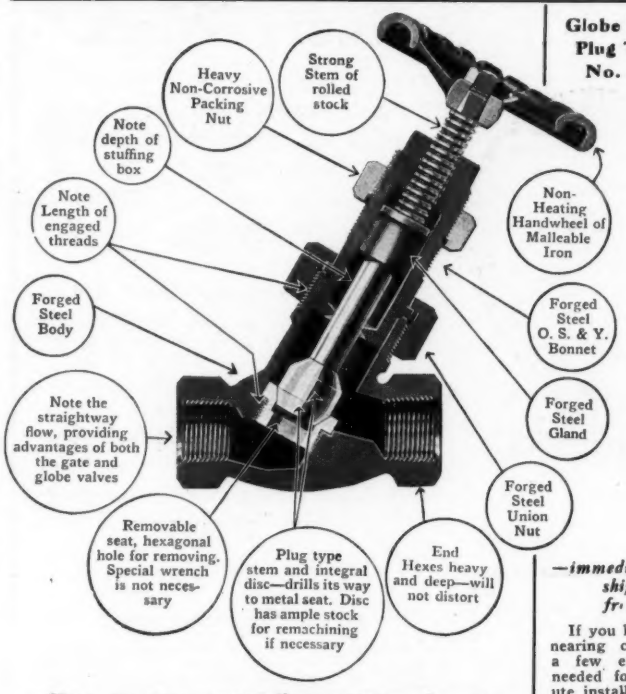
There is much opinion regarding the life of modern metals compared with those produced some 25 years ago. Some iron vessels in service 25 years are giving less trouble from corrosion than those constructed in the last few years. It is said that the condenser tubes of admiralty metal formerly lasted ten years, while their life today in the same condensers under the same conditions is only about two years.

Much trouble is experienced from tankers from leaky rivets, and as this allows oil to leak out it is serious. The rivet head is probably anodic to steel plate and an endeavor is being made to locate a material that will be slightly negative to steel and will be free from auto corrosion.

Corrosion from light oils in tankers is a subject of complaint. This corrosion may be due to the rapid evaporation of oil allowing moisture to condense, to its scale removing action or to the sulphur compounds in the oil. A test was made recently of metals sprayed on a tanker bulkhead, aluminum, copper, brass and zinc were applied. On the first trip the copper was half gone, the brass was slightly attacked, but the aluminum showed no attack. No water was carried. This conforms with tests made on the corrosiveness of various sulphur compounds in light oils.

From an accident prevention standpoint the experience in applying sprayed metal may be interesting. The tank was thoroughly steamed out as usual when men are to work in it. There was no odor of gas, but when the sand blast operated a few minutes re-

Edward Forged Steel Valves


Globe Valve
Plug Type
No. 682
Heavy Non-Corrosive Packing Nut
Strong Stem of rolled stock
Note depth of stuffing box
Note Length of engaged threads
Non-Heating Handwheel of Malleable Iron
Forged Steel Body
Forged Steel O. S. & Y. Bonnet
Note the straightway flow, providing advantages of both the gate and globe valves
Forged Steel Gland
Forged Steel Union Nut
Removable seat, hexagonal hole for removing. Special wrench is not necessary
Plug type stem and integral disc—drills its way to metal seat. Disc has ample stock for remachining if necessary
End Hexes heavy and deep—will not distort

Here are two outstanding reasons why you should standardize on Edward Forged Steel Valves.

(1)—designed and built for service up to 500 pounds pressure and intermittent temperatures to 1100° degrees F.—they therefore will fit any service need within this range.

(2)—because of quantity production these high grade valves are priced LOW ENOUGH to justify their use even in service far below their maximum rating.

—immediate shipment from stock

If you have a plant nearing completion—a few extra valves needed for last minute installation — an emergency arises where valves are needed quickly—wire Edward — specify "Forged Steel Valves" — immediate shipment will be made — any quantity and any size from ¼-inch to 2-inch inclusive.

Edward Forged Steel Valves are made in both Globe and Angle pattern—Plug Type or Edward Protected Seat and Disc.

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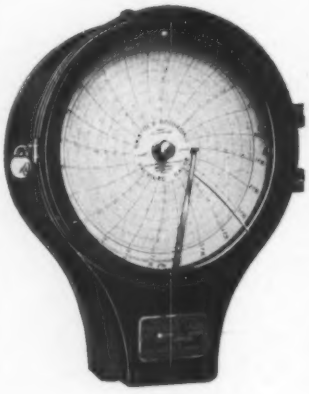

Bristol's Instruments are made, first of all, to give accurate records of temperature, pressure, liquid level, and other factors in refining operations.

But this sharp accuracy has a further merit in the Bristol way of instrument making. It is attained by construction that assures continuously reliable operation despite the exposure and other details of service that make refinery service exceedingly trying on instruments of precision.

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moving the scale, the liberated gas drove the workmen out. This suggests one of the bad features of tank corrosion where the scale may contain much oil, and a possible cause of explosions when the old tanks are being repaired.

Atmospheric Corrosion

Oil refinery atmosphere will contain comparatively large amounts of CO_2, H_2S and SO_2; where humidity is high, as near the sea, moisture in excess is present on all exposed material. Galvanizing is not very effective in many parts of refinery; by continually painting some protection is obtained. Aluminum paint is very promising in this connection.

Conclusion

Cast iron, wrought iron and steel are being used economically and satisfactorily for nearly all refinery construction. In isolated cases it is desirable to reduce the frequency of failures, as interruption of continuous operation is equivalent to loss of capacity. To this end we are striving to apply new ideas and material when they seem feasible and economical. Often a slight change in design or operating method will greatly reduce trouble.

Such metals as nickel, monel, aluminum, chromium and chrome-nickel-steel would appear to take care of most special refinery corrosion, and their use will extend as price is reduced. Reduction of hydrogen ion concentration can be accomplished in some cases. Laboratory testing of metals gives a fair indication of the proper metal to try, but of course, does not give accurate quantitative data. Electrolytic polarity is a test that should always be made on metals for underwater application. The data from these tests should be checked by that from samples applied as near as possible to actual working conditions.

We speak glibly of sulphur corrosion but with the knowledge that there are over a dozen compounds of sulphur found in crude oil. We know something of the chemical action of H_2S, SO_2, S and H_2SO_4 when in the presence of water, oxygen, HCl, and Cl_2. The chemical action on metals, their oxides and sulphides is also known, and all of these conditions are to be taken into consideration when dealing with refinery corrosion. By correlating the corrosion results on various metals or alloys as experienced, with laboratory tests, a fair idea may be obtained as to the principal corrosive agent present.

Reporting corrosion in terms of depth-per-year seems desirable, the pitting data, however, is harder to consistently define.

The scrap pile in a large refinery may represent a direct loss of over a quarter of a million dollars a year, which, with better knowledge and concentrated effort, may be reduced a third.

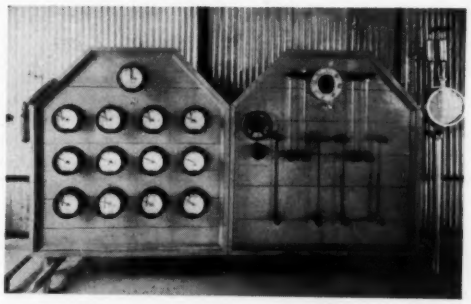
Recent Refinery Patents

Washington, D. C.—The following patents of interest to the refining industry have been granted by the United States Patent Office:

No. 1,607,939, granted November 23 to Friedrich Bergius, Heidelberg, Germany, for a process for hydrogenating and cracking hydrocarbons, consisting in introducing hydrogen into the vapors produced in a reaction vessel, passing the mixed gases and vapors through a condenser, washing under high pressure the uncondensed gases with wash oil, returning the hydrogen-containing gases to the reaction vessel, removing absorbed hydrocarbon gas from the wash oil, heating such gas at high temperature to decompose it into carbon and hydrogen, and introducing the thus produced hydrogen into the reaction vessel.

No. 1,607,942, granted November 23 to Charles Henry Brown, Breckenridge, Texas, for an apparatus for the abstraction of gasoline, consisting in combination of means supplied with a quantity of absorber oil which is in excess of the quantity required to absorb the lower Baume gravity gasoline for causing absorption of the lower Baume gravity gasoline, means for supplying the first mentioned means with gasoline-laden gas, a still for separating said gasoline from the absorber oil, a heat exchanger connected with the first-mentioned means for receiving the gas carrying only the higher Baume gravity gasoline for cooling said gas, a second absorber tank connected with the heat exchanger, means for introducing absorber oil into the top of the tank, and means connecting the heat exchanger with the body of the tank whereby the higher Baume gravity gasoline laden gas is charged into the bottom of said tank whereby the gas flows upward through the down stream of the absorber oil, a plurality of tubes located in the tank, chambers at the top and bottom of the tank and connected by the tubes but out of communication with the body of the tank, means connecting the space in the tank around the tubes with the lower chamber whereby the absorber oil charged with higher Baume gravity gasoline is permitted to enter the tubes whereby the heat caused by the absorber oil absorbing the higher Baume gravity gasoline is imparted to the tubes and to the absorber oil charged with higher Baume gravity gasoline passing through said tubes, and means for maintaining a lower pressure in said tubes and chambers than in the tank space around said tubes.

No. 1,607,966, granted November 23 to George L. Prichard and Herbert Henderson, Port Arthur, Tex., assig-



There Is Nothing Unusual About this Instrument Board

The Manhattan Refining Co., Cassody, Kansas, is just another example of the growing number of plants which are 100% Foxboro equipped. In the photograph above only fourteen of the Foxboro Instruments installed in this natural gasoline plant are shown.

Refining companies all over the world find that with FOXBORO INSTRUMENT CONTROL gasoline yield is invariably high. On cracking stills, knock-out boxes, dephlegmators, fractionating towers, condensers, wax heaters, storage tanks, in fact, for every critical process there is a Foxboro Instrument for indicating, recording and controlling the temperature, pressure, humidity or flow.

All Foxboro Instruments are guaranteed permanent in calibration and are accurate to within less than 1 per cent of total scale range. They have proved themselves ideally adapted to refinery work.

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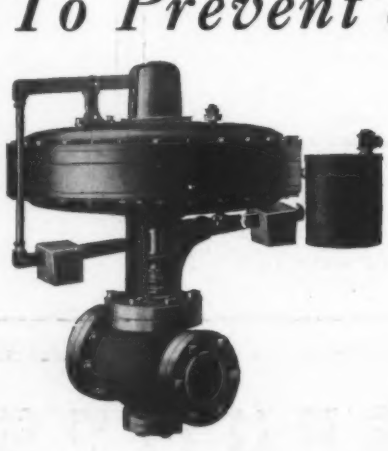

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nor to Gulf Refining Co., Pittsburgh, for a process of converting higher boiling petroleum oils into lower boiling oils which comprises establishing and maintaining a body of such higher boiling oil and aluminum chlorid, passing heated oil in heat transferring relationship but without contact therewith in said body at a temperature sufficient to cause boiling thereof, and condensing and collecting lower boiling oil formed.

No. 1,608,016, granted November 23 to James Conway, Drumright, Okla., for an oil separator including a vessel for water provided with tube plates at its top and bottom, a fire-box arranged below the bottom tube plate, a smoke-box arranged above the top plate and provided with a chimney, straight heating tubes for the water extending between the two tube plates, perforated spray pipes for oil arranged vertically below the lower parts of the heating tubes in the water space between them, an inlet pipe for oil projecting through the side of the vessel, and branch pipes connecting the inlet pipe with the lower ends of the spray pipes.

No. 1,608,089, granted November 23 to Gustav Egloff and Harry P. Benner, Chicago assignors to Universal Oil Products Co., Chicago, for a process of refining hydrocarbon oils, which consists in introducing a bulk supply of oil to a still, in adding to said oil while in the still comminuted fuller's earth and caustic soda and subjecting the oil with said added substances to a distilling temperature.

No. 1,608,135, granted November 23 to Jacque C. Morrell, Chicago, assignor to Universal Oil Products Co., Chicago, for a process of recovering resinous materials from cracked hydrocarbon distillates, consisting in distilling the oil in the presence of an absorbing agent, subjecting said agent to the action of a solvent to remove the absorbed materials, and evaporating the solvent liquid.

No. 1,608,328, granted November 23 to Almer McDuffie McAfee, Port Arthur, Tex., assignor to Gulf Refining Co., Pittsburgh, for the improvement of petroleum oils by increasing their hydrogen content through a process which comprises heating a body of asphaltic-petroleum oil with gas rich in hydrogen in the presence of aluminum chlorid until contained asphalt substantially disappears.

No. 1,608,329, granted November 23 to Almer McD. McAfee, Port Arthur, Tex., assignor to Gulf Refining Co., Pittsburgh, for a process of improving cracked gasoline which comprises warming a body of such gasoline with anhydrous aluminum chlorid under circumstances precluding distillation and supplying gases relatively rich in hydrogen to the reaction mixture.

No. 1,608,339, granted November 23 to Harry M. Ridge and William Richard Hodgkinson, London, Eng., for a process of purifying oils or the like,

particularly of removing sulphur therefrom, which consists in bringing the oil into contact with a material comprising copper, an oxide of copper and a halide of copper.

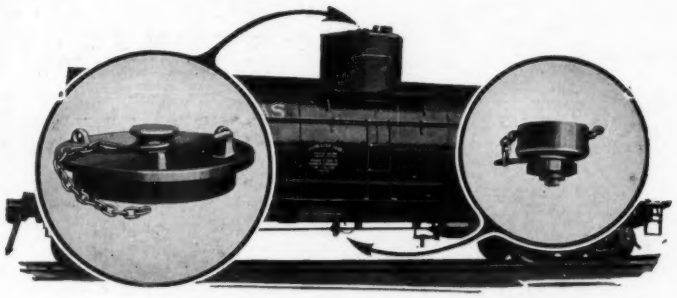
No. 1,608,416, granted November 23 to Daniel L. Newton, Fullerton, Calif., for an apparatus for a continuous process of absorbing condensible hydrocarbon vapors contained in casing head as by means of a liquid medium and in which said medium is conducted in one direction and the gas in the opposite direction, comprising plurality of compartments vertically arranged in series, each of said compartments being adapted to contain said liquid medium and having a bottom provided with perforations through which the gas enters, a cylindrical recirculation tube open at the top and provided with side openings near the bottom and vertically disposed over each of said perforations, said tubes being arranged in approximately parallel rows, baffle plates between said rows of tubes extending above the level of the liquid medium, and means for maintaining the level of the absorbing medium at a height substantially twice the height of said tubes.

No. 1,608,664, granted November 30 Bernard Ormont, New York, assignor to Bernard Ormont Associates, Inc., New York, for a method of vaporizing hydrocarbon oil which consists in introducing said oil and water into a heater at separate points; vaporizing the lighter ends of said oil while creating a region of nascent steam out of contact with said lighter ends; leading the unvaporized oil to said region to completely vaporize the same; and conveying the combined vapors of all of said oil and water out of said heater.

No. 1,608,741, granted November 30 to Francis M. Hess, Whiting, Ind., for a vapor box for effecting fractional distillation, comprising a pair of W-shaped groups of heating plates internested to form a continuous zigzag conduit for the gravity flow of the crude material through the same and sealing said conduit against the counter flow of the vapor distillate through said seal.

No. 1,608,767, granted November 30, to James H. Burlingham, Port Arthur, Tex., assignor to the Texas Co., for a scraper for stills, comprising a rotatable shaft, a plurality of pairs of arms, a lever attached to each scraper, a chain attached to each lever, a weight carried by each chain whereby each scraper is adjustably held against the wall of the still.

No. 1,609,000, granted November 30 to Benjamin B. Schneider, Wilmette, Ill., assignor to Standard Oil Co., Whiting Ind., for a method of converting hydrocarbon oils into lower boiling hydrocarbon oils which comprises maintaining separate units, in each of which oil is passed through a heating coil in which it is brought to conversion temperature, the heated oil from said heating coal is forced into an enlarged



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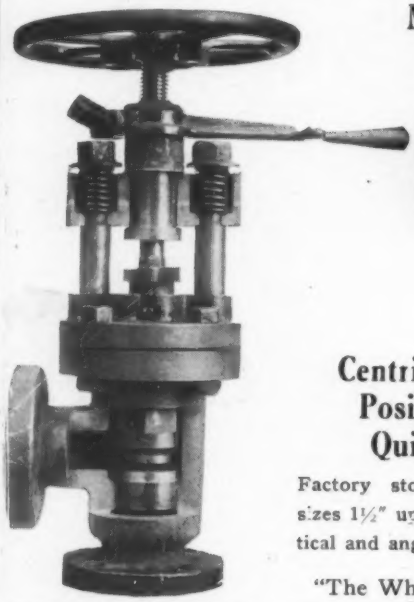

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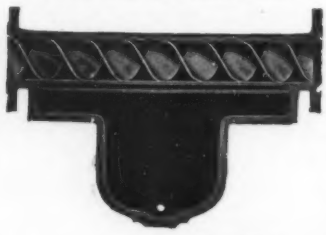

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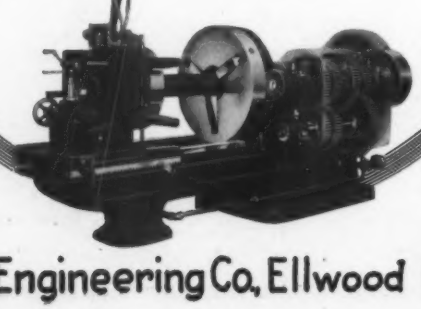

Standard Engineering Co, Ellwood City, Pa.

chamber in which it is retained at conversion temperature until substantial conversion has taken place, and vapors from the conversion chamber pass to a dephlegmating zone, passing fresh oil through a closed conduit in the dephlegmating zone of one of said units, thereby producing a desired cooling and refluxing action therein, discharging a desired proportion of oil from said conduit into the heating coil of another unit, and discharging the remainder into a reservoir.

No. 1,609,001, granted November 30 to Benjamin B. Schneider, Wilmette, Ill., assignor to Standard Oil Co., Whiting Ind., for an apparatus for the conversion of hydrocarbon oils, comprising a plurality of units each comprising a heating coil, in which oil is heated to chamber maintained at conversion temperature into which oil from the coil is discharged, means for withdrawing unvaporized oil from the chamber, a dephlegmating tower, means for discharging vapors from the enlarged chamber to the dephlegmating tower, and means for forcing reflux from the deflegmating tower to the heating coil of each unit; a coil in each dephlegmating tower; means for supplying cold oil to each said coil, whereby a cooling and refluxing action is secured in the dephlegmating towers; and means for conducting oil from each said coil to the heatig coil of a unit other than that in the dephlegmating tower of which the coil is located is a part.

No. 1,609,007, granted November 30 to Daniel R. Weller and Louis Link, Baton Rouge, La., assignors to Standard Development Co., for a process of fractional distillation and condensation of crude petroleum which consists in heating a body of oil, subjecting the vapors to a succession of fractional condensations, the condensate from each of said condensations being returned to the still out of contact with the vapors undergoing condensation, and out of contact with other condensates in the preceding condensation step or steps, and separately condensing and collecting the vapors passing uncondensed through the said succession of condensations.

No. 1,609,023, granted November 30 to Frank A. Howard, Elizabeth, N. J., assignor to Standard Development Co., for a method of jointly manufacturing carbureted water gas and volatile hydrocarbon motor fuel which consists in air blasting a bid of carbonaceous fuel to incandescence, passing the heated blast gases as produced over heat absorbent material, to heat the same to a temperature between 850 degrees F. and 1050 degrees F., steam blasting the incandescent bed to produce water gas, passing the heated water gas over the said heated material, injecting into the current of heated water gas a heavy hydrocarbon oil and thereby causing the oil in vaporized form to pass with the water gas over the said heated ma-

terial, controlling the rate of flow of the mixed water gas and oil vapors, with reference to the temperature of the said heated material, so as to secure a production of fixed hydrocarbon gas not less than 15 per cent nor more than 60 per cent of the weight of oil injected, cooling the mixed gases and vapors to cause condensation of the vaporous portion thereof, separating the condensed oil including volatile hydrocarbon motor fuel from the fixed gases, and controlling the amount of injected oil so that the said fixed gases shall have an average b.t.u. value of not less than 450 nor more than 650 per cubic foot.

No. 1,609,135, granted November 30 to Walter F. Statham, Bartlesville, Okla., assignor, by mesne assignments, to Doherty Research Company, New York, for a scraping mechanism for removing sediment from stills, comprising a pivotally supported scraping device, means under the influence of gravity tending to rotate said device about its pivot, said means comprising a member adapted to impart a blow to said device at a point removed from the pivot thereof and thereafter to exert pressure on the scraping device at said point.

No. 1,609,349, granted December 7 to Francis I. DuPont, Wilmington, Del., assignor to Delaware Chemical Engineering Co., Wilmington, for a process of distilling petroleum comprising floating a body of petroleum to be distilled on a fluid metal in a vessel, withdrawing a part of the fluid metal to a point outside the vessel, applying heat to the fluid metal while outside of the vessel, and returning the heated fluid metal to the vessel in an unbroken stream.

No. 1,609,546, granted December 7 to Ford W. Harris, Los Angeles, assignor to Petroleum Rectifying Co., of California, Los Angeles, for a process of separating water from emulsions which comprises adding solid particles to the oil and thereafter agglomerating the water about these particles by the use of an electric current.

No. 1,609,667, granted December 7 to Thomas W. Sowell, Dallas, Texas, assignor to The Portable Refinery Co., Dallas, for a portable refinery unit, consisting of a crude oil still, a heat exchanger having a crude oil inlet, means for circulating heated oil from the still through the exchanger and returning it to the still, a pipe for conducting heated oil from the exchanger discharging directly into the still, a cooling tower connected with the still, and a vapor discharge pipe from said tower.

No. 1,609,822, granted December 7 to Carlyle Jefferson, New York, assignor to The Griscome-Russel Co., New York, for an apparatus for petroleum refining comprising a containing shell having upper and lower portions, heat transferring tubes within the upper portion the lower ends of the tubes opening into the lower portion of the shell, means for circulating a cooling

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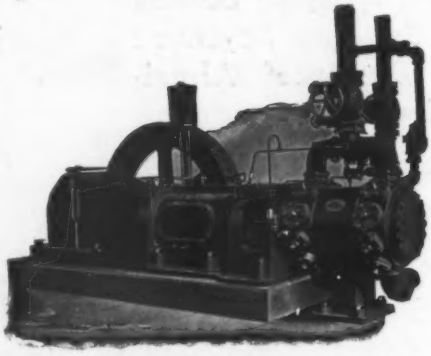

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medium through the upper portion of the shell in heat transferring relation with the tubes therein to thereby condense a portion of the vapors traversing the interior of these tubes, the condensate thus formed draining under the influence of gravity into the lower portion of the shell, heat transferring means in said lower portion for receiving said condensate, and an inlet for admitting hot vapors to said lower portion, said heat transferring means being adapted to convey said condensate downwardly in film-like form and to bring said hot vapors into heat exchanging relations with said condensate so as to re-evaporate the more volatile portions thereof, the vapors thereafter entering the tubes in the upper portion of the shell, means for withdrawing from the lower portion of the shell the condensate which is not re-evaporated, and means for withdrawing from the upper end of the apparatus the vapors passing the heat transferring tubes uncondensed.

No. 1,610,523, granted December 14 to Francis M. Hess, Whiting, Ind., for a process of distilling hydrocarbons under pressure to produce lower boiling point hydrocarbons, which consists in passing the crude material through a still, subjecting the same in said still to the heat of a fluid heating medium and residuum out of contact with both of the latter, said heating medium and residuum being maintained out of contact with each other, passing the vapors and residuum from said still into a dephlegmator out of contact with each other, returning the reflux from said dephlegmator to said still, and passing the uncondensed vapors from said dephlegmator to a condenser.

No. 1,610,594, granted December 14 to Milly Rowe, Los Angeles, for an oil refining apparatus consisting of a still having a fire chamber, means for producing combustion within the fire chamber, a jacket concentric with the fire chamber and forming therewith a vapor chamber, a partition member having its central portion concentric with the vapor chamber, a dome for the still, and a tube extending within the dome and from the upper part of the concentric jacket, and having its open end communicating with the upper part of the dome.

No. 1,611,082, granted December 14 to Adolphe Antoine Francois Marius Seigle, Paris, France, for an apparatus for cooling hydrocarbon gases and vapors consisting of a vertical receptacle, a central chamber extending axially through said receptacle, means for admitting the supply of the hydrocarbon gases and vapors to be treated to the space within said receptacle and around said central chamber, a jacket surrounding said receptacle, means for supplying cooling fluid to said central chamber and to the space between said jacket and said receptacle and an outlet at the upper part of said receptacle for the noncondensed gases and vapors.

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Witherspoon Operating San Antonio Plant

San Antonio, Texas.—C. L. Witherspoon and associates of San Antonio have purchased the 700 barrel daily capacity skimming and lube plant of the Southern Refining Company at Somerset, near San Antonio, and the plant is now being operated as the Witherspoon Refining Company. The new refining concern is a Texas corporation, having a capital stock of 1000 shares of no par value. The officers of the company are: C. L. Witherspoon, president; J. B. Jarmon, vice-president; and H. O. Rosendahl, secretary-treasurer. E. M. Corah is general manager and superintendent of the plant.

Install Jenkins Process in Shreveport Plant

East Chicago, Indiana.—The Graver Corporation has recently sent out a bulletin stating that the Corco Oil Refining Corporation of Shreveport, Louisiana, has contracted for two high pressure Jenkins Cracking Process units to be installed at the Shreveport refinery. Graver will install the units.

J. A. Campbell, of the Campbell Petroleum engineering firm of Long Beach, and inventor of the Campbell Oil Froth absorbers and other gasoline plant equipment has established a branch office at Taft, California, where the business of the northern part of California will be handled. Mr. Sid W. Mims will represent the Campbell company, with headquraters at the Fix Hotel, Taft. Another branch office of the company is soon to be established at Tulsa.

The Botfield Refractories Company of Philadelphia has just finished distribution of a desk fold, which has been sent to officials of the leading refineries of the United States and Canada.

Each fold has the name of the individual, to which it was sent, imprinted on the outside cover. While the fold is an advertisement, all data of this type is inside the fold.

The product was prepared and distributed through the B. M. Brasford Company, advertising, 17 East 42nd St., New York.

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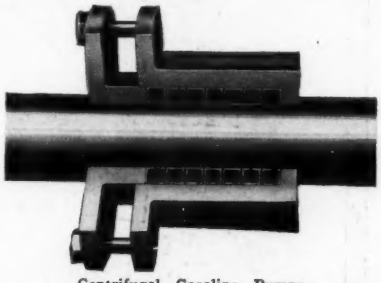

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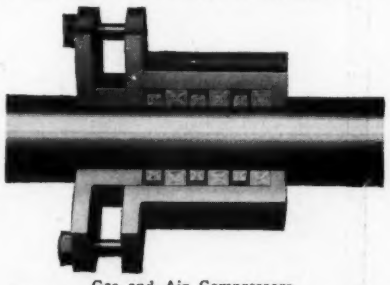

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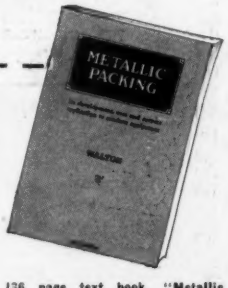

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Tables of Decimal Equivalents
Dimensions of Gaskets for Extra Heavy and Medium Flanges
Dimensions of Gaskets for Standard and Low Pressure Flanges
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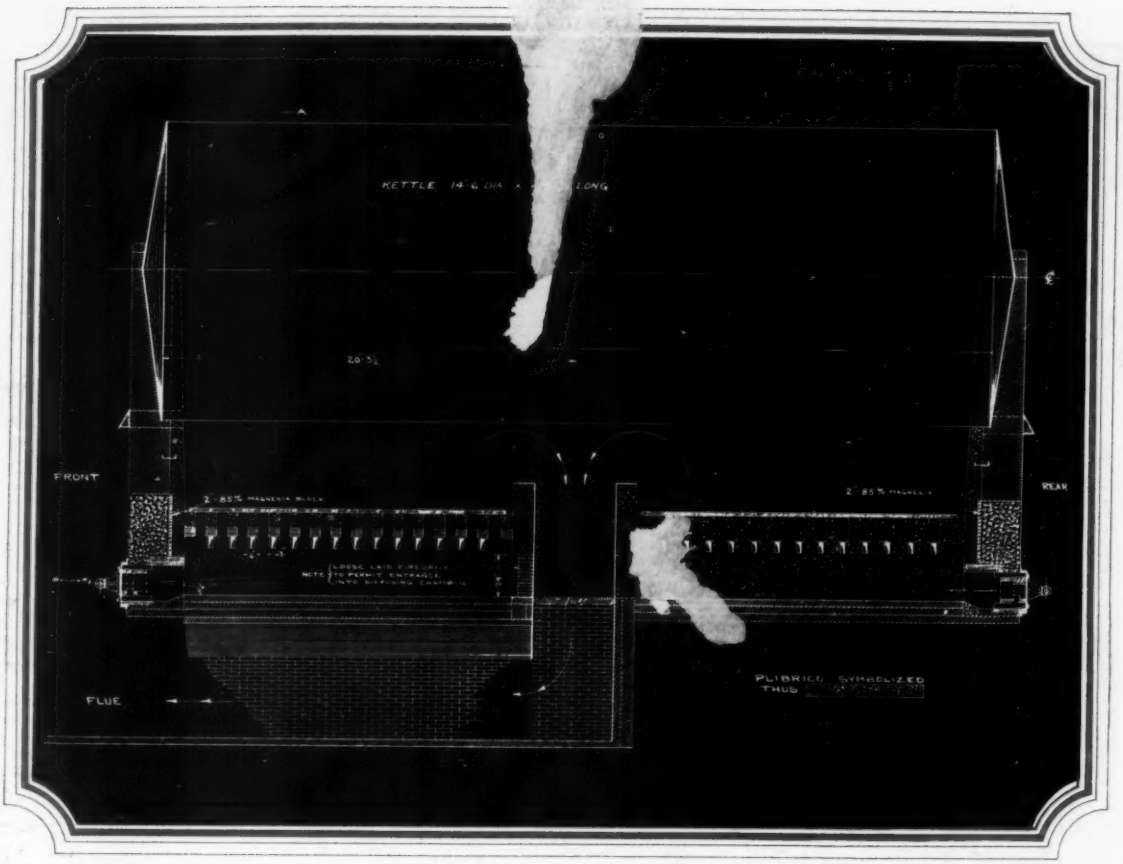

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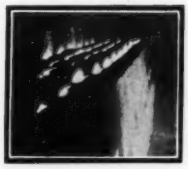

How a double-end-fired Diffusing Furnace was adapted to a 14′ 6″x40′ 7″ still is shown above. Our engineering department will be glad to prepare blueprints showing how the Diffusing Furnace can be adapted to your stills.

Every square foot of still bottom receives the same amount of heat, so perfect is the temperature control. No portion is underheated—no capacity is lost.

Any new or old still can have this new-day firing method if it's heated by gas or oil. The cost is low. Present brickwork usually need not be disturbed. Sometimes the installation of the tunnel-like combustion chambers is all that is necessary.

Investigate the greater capacity of this modern furnace, and its other advantages —elimination of buckling, greater fuel economy, lengthened refractory life.

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Largest manufacturers of plastic refractories
1865 Kingsbury Street, Chicago
Factories: Chicago and Trenton, offices in 90 cities

The PLIBRICO Diffusing Furnace

—for old or new stills, oil or gas fired

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—A Fire. Strong Wind. Flames Roaring Against Nearby Tanks Full of Gasoline. Tanks Seared and Blistered—BUT OTHERWISE UNINJURED.

The refiner who reported this situation to us gave full credit to McDonald Duplex Tank Vents for saving these tanks.

And McDonald Vents always "come through" both extreme and ordinary conditions because they are mechanically perfect for automatically equalizing external and internal pressures on storage tank walls.

Notice their simplicity of construction. By raising the lid, all working parts are before you at a glance. A removable screen prevents back fire and allows full opening for gauge rod.

Why pay exorbitant sums for a heavy complex arrangement when our simple, inexpensive vent—LISTED AS STANDARD BY THE UNDERWRITERS—gives positive protection. Write for further information and prices.

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